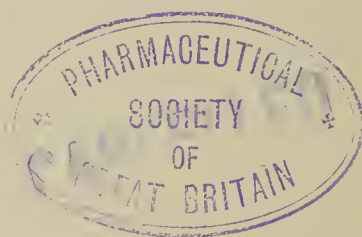






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VOLUME XLVII.—1883.

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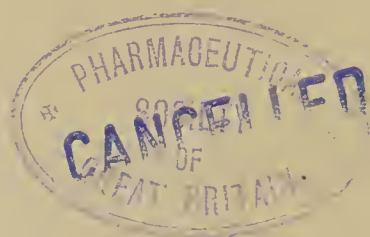
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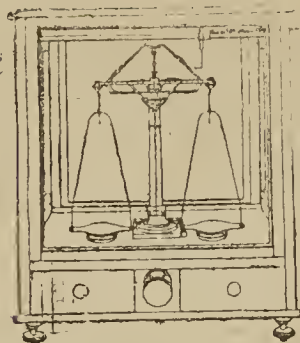
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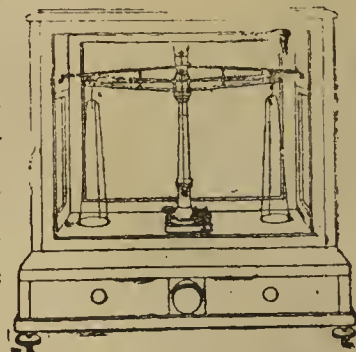
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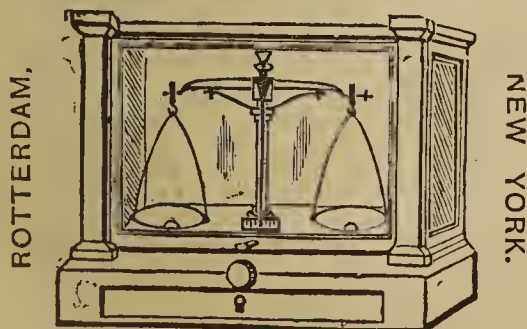
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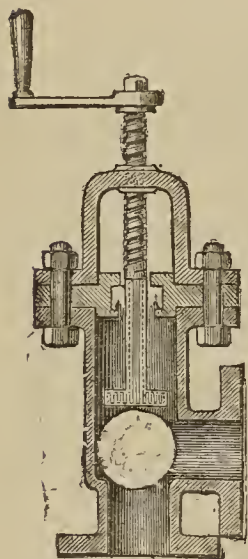
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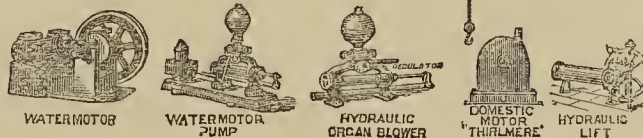
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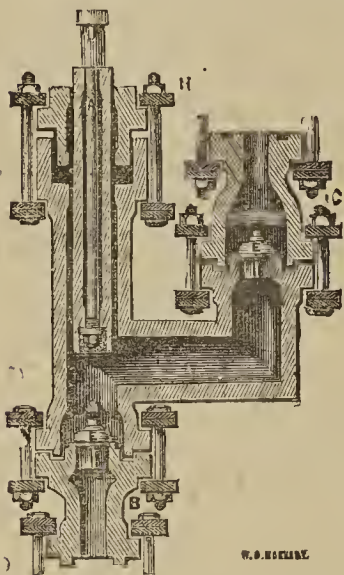
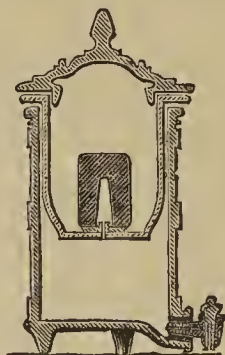
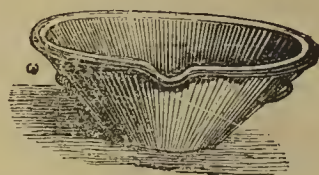
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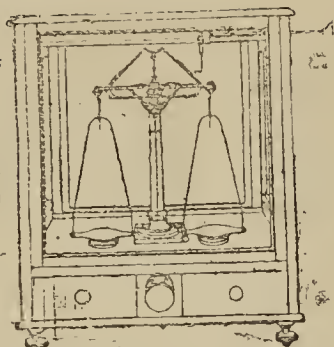
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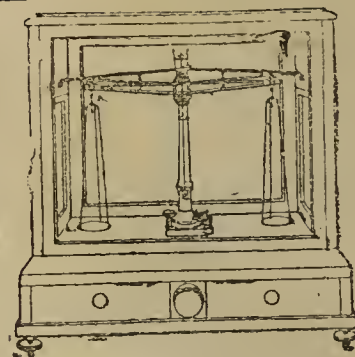
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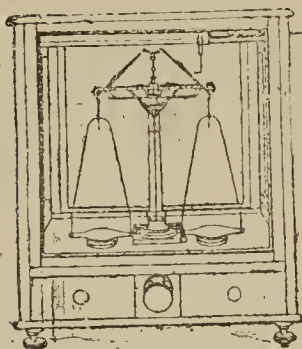
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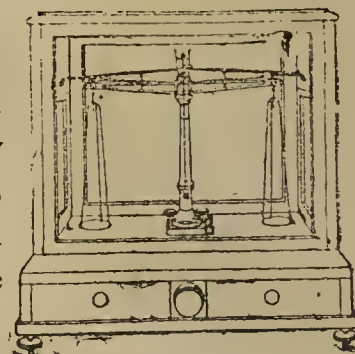
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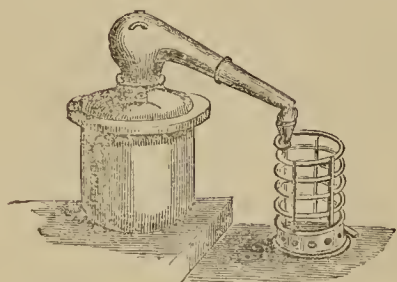
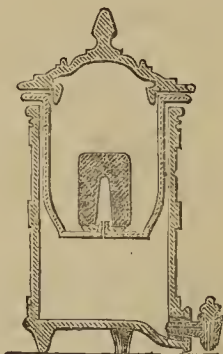
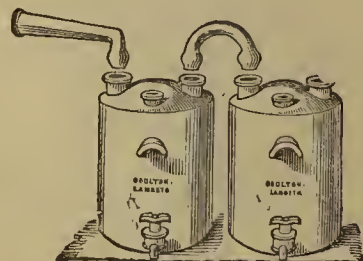
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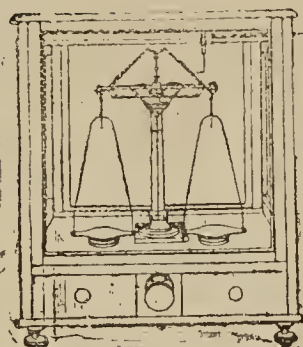
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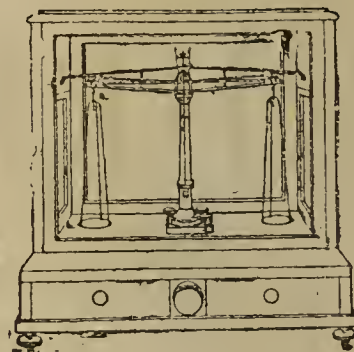
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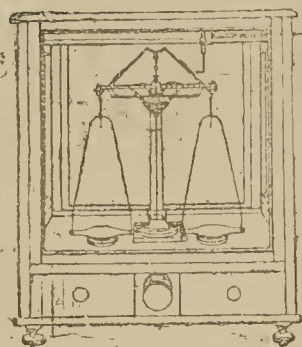
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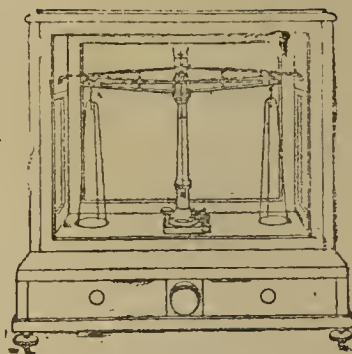
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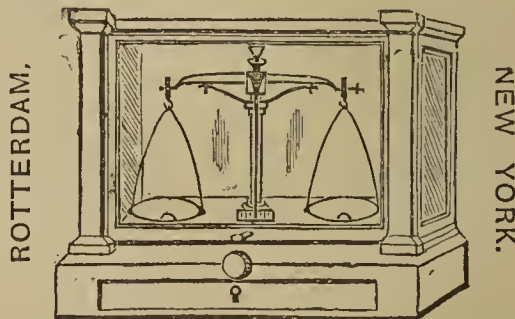
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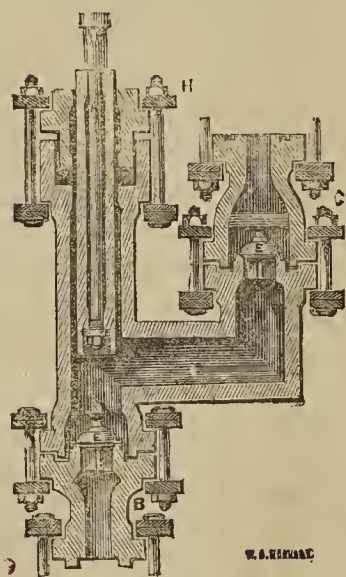
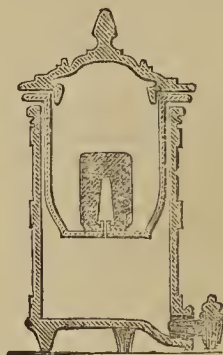
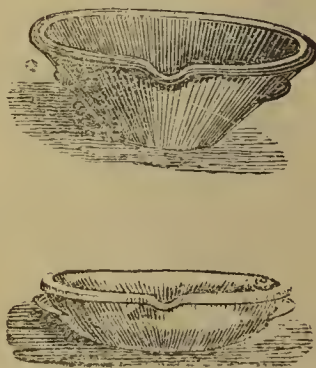
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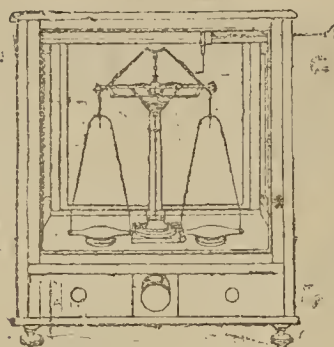
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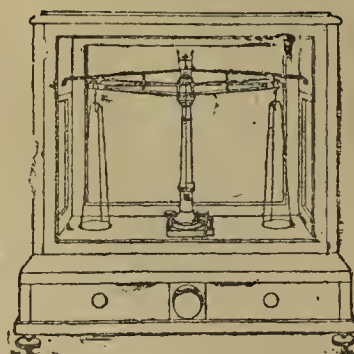
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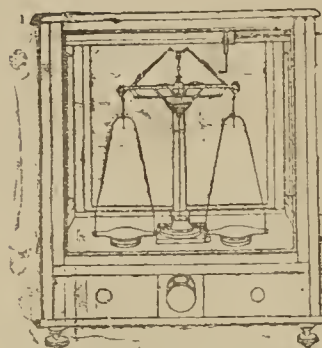
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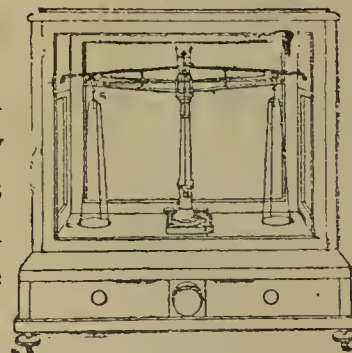
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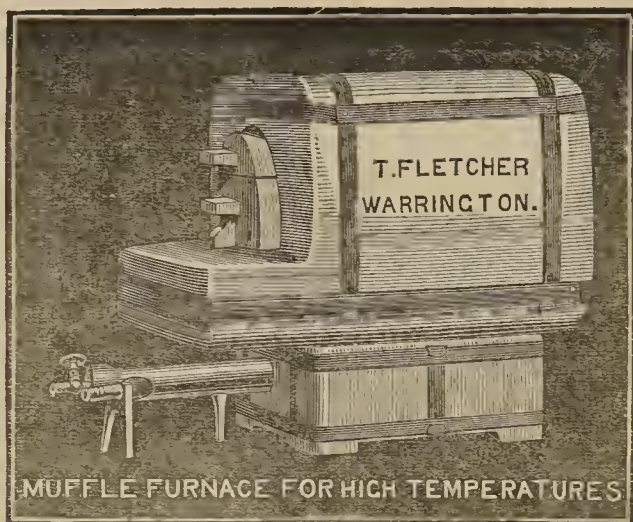
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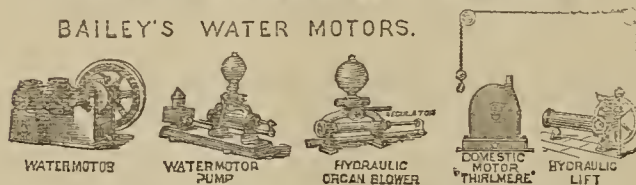
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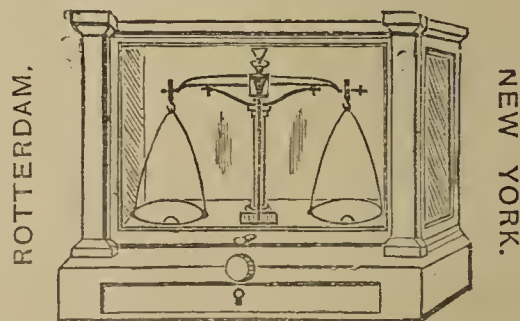
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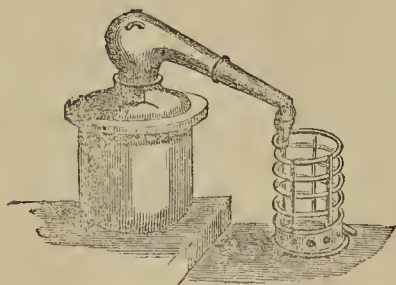
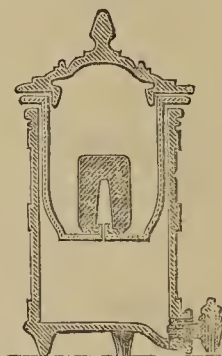
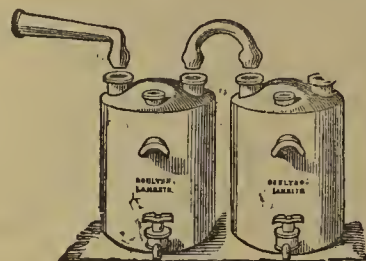
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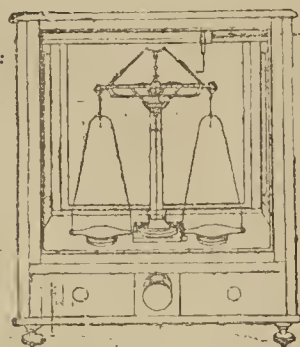
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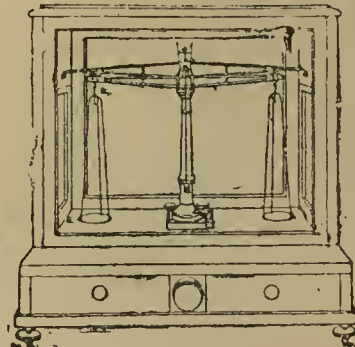
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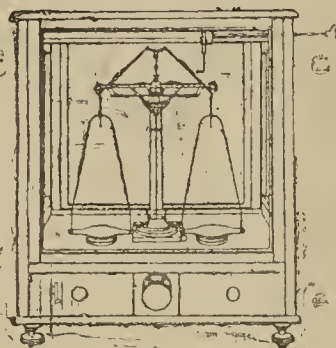
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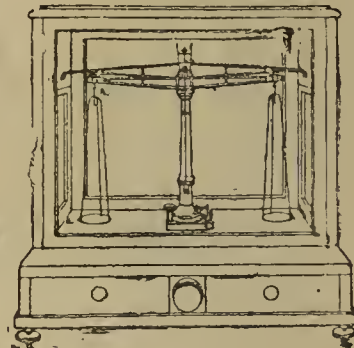
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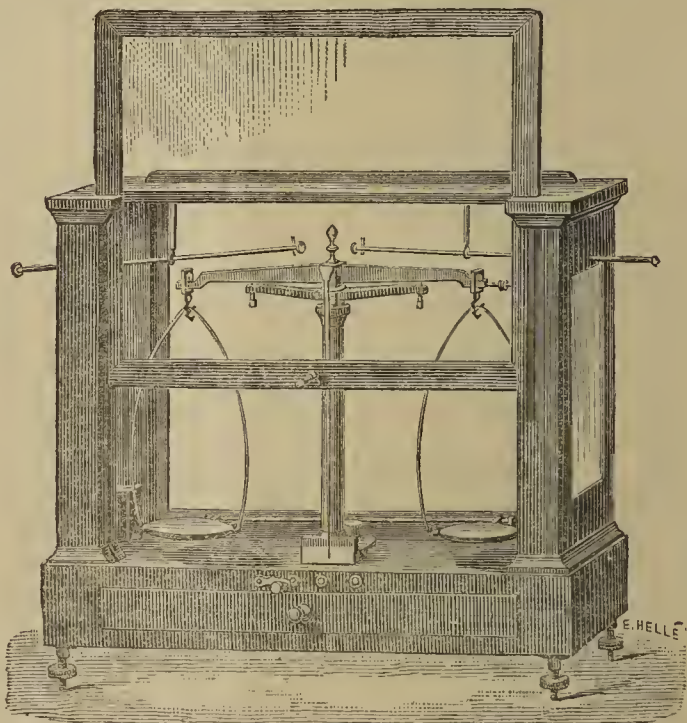
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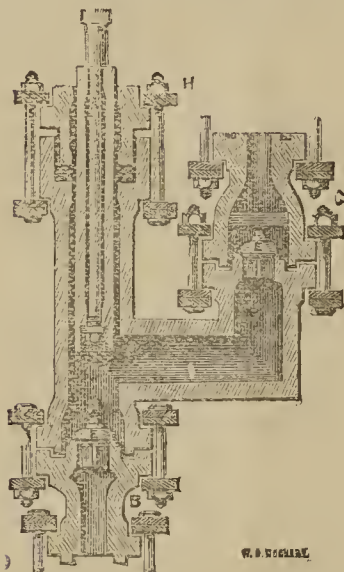
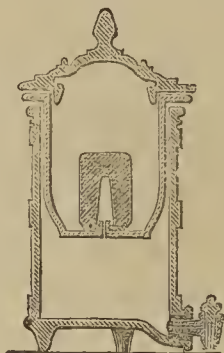
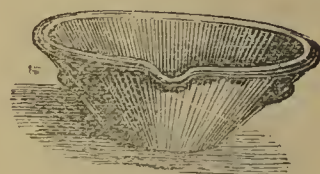
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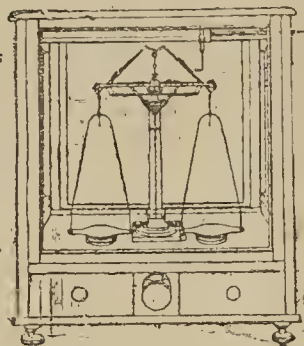
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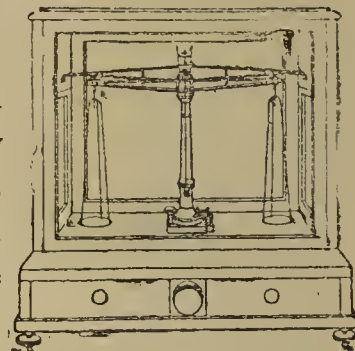
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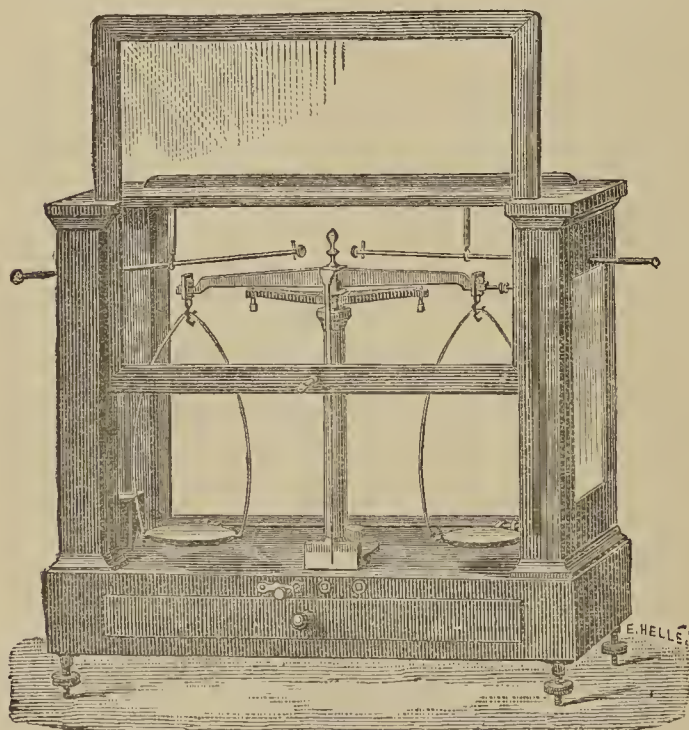
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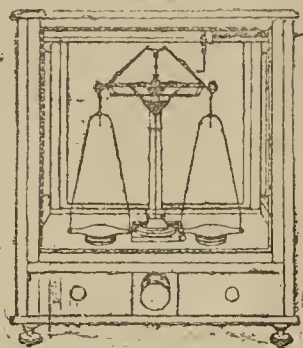
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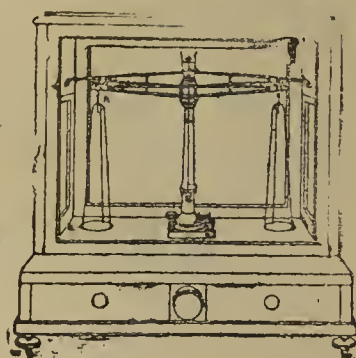
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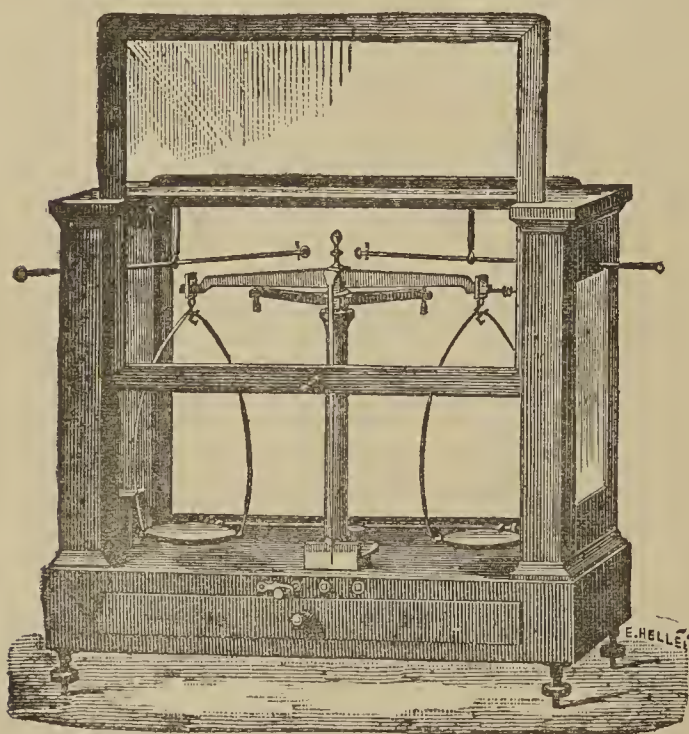
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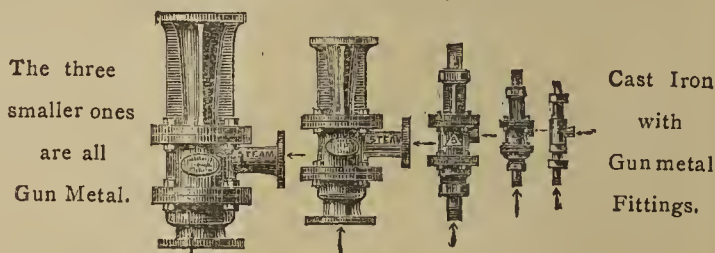
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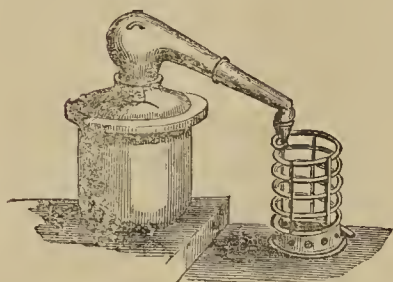
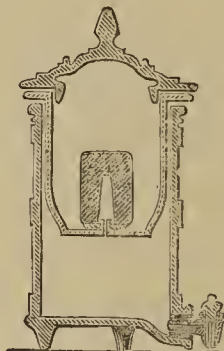
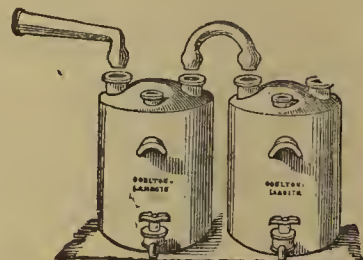
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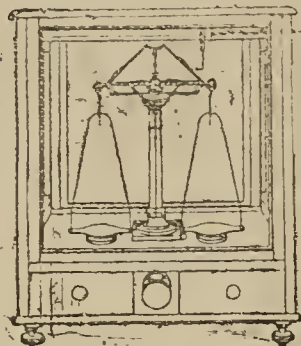
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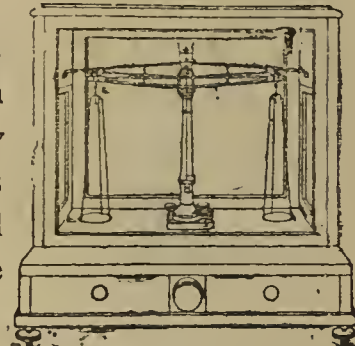
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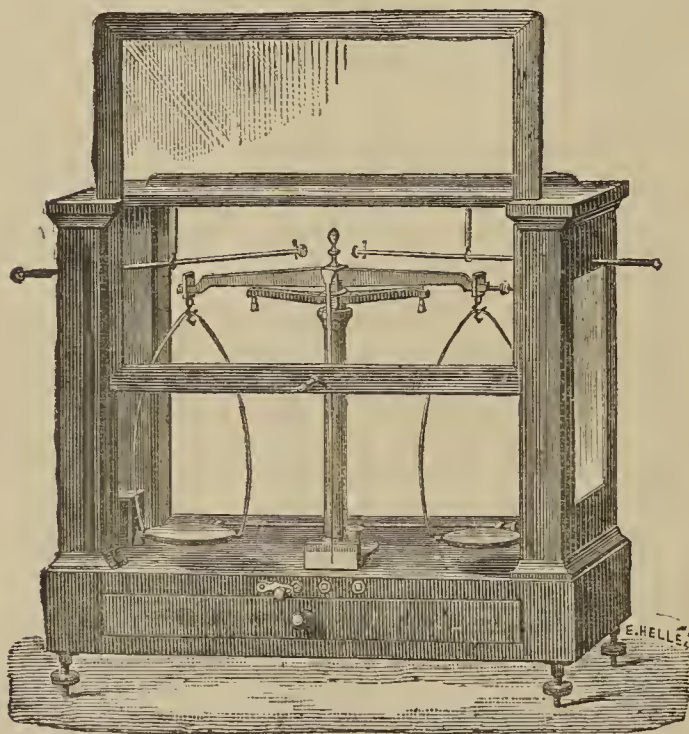
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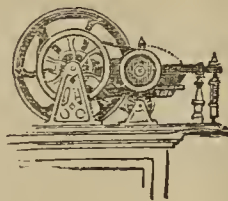
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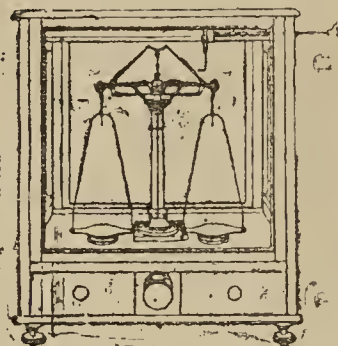
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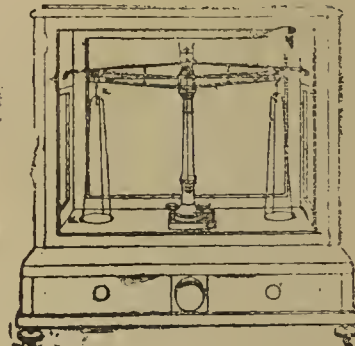
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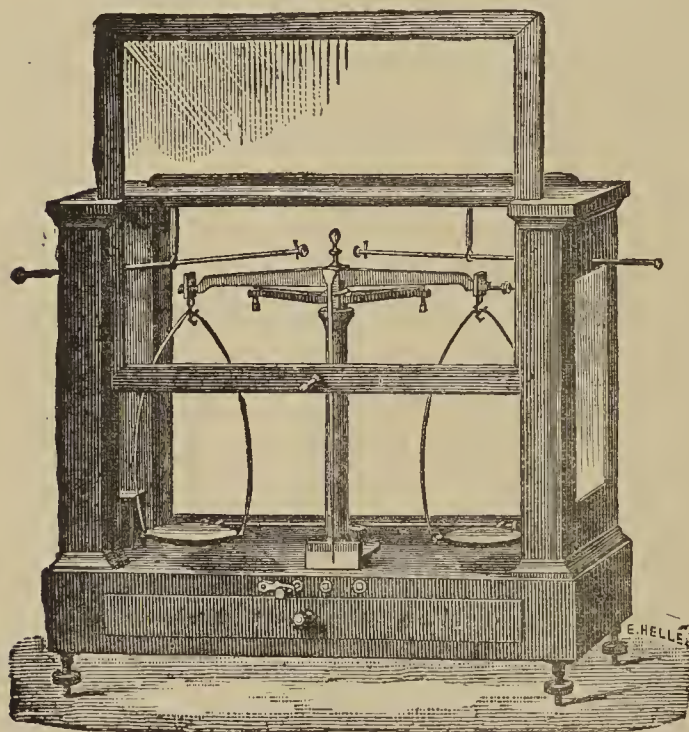
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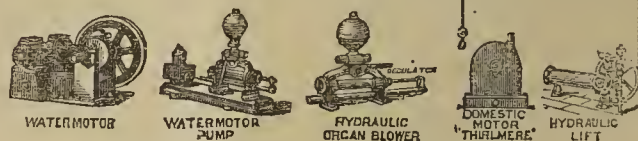
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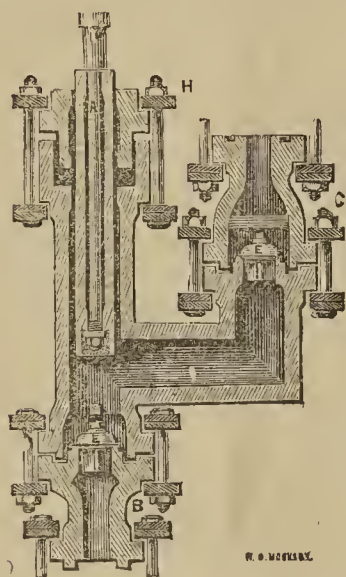
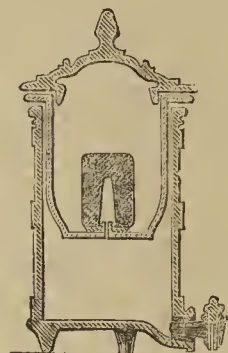
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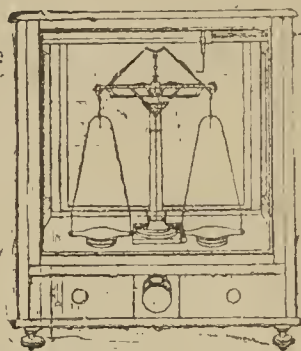
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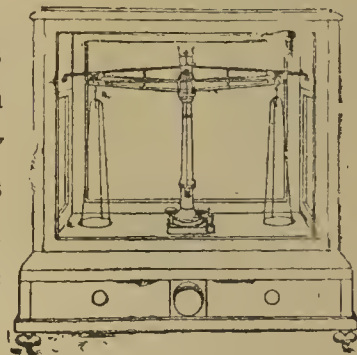
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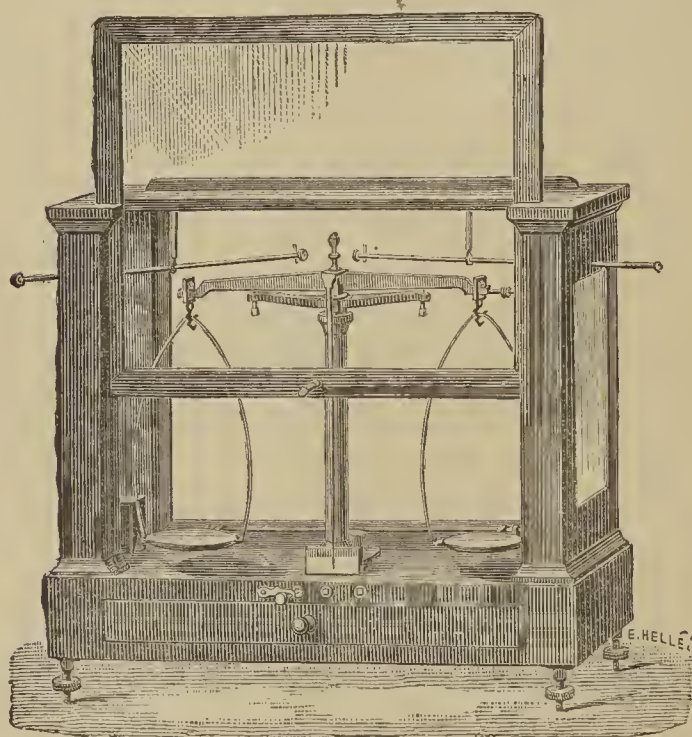
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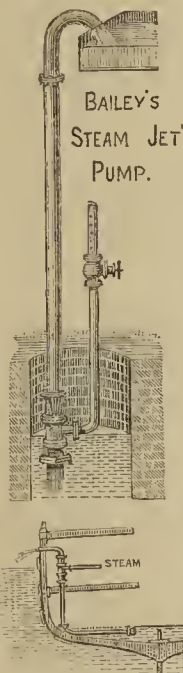
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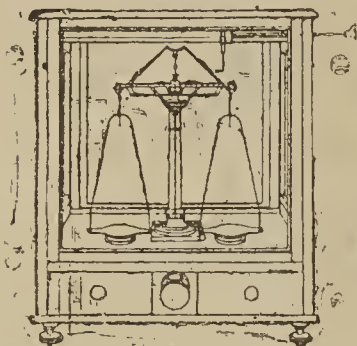
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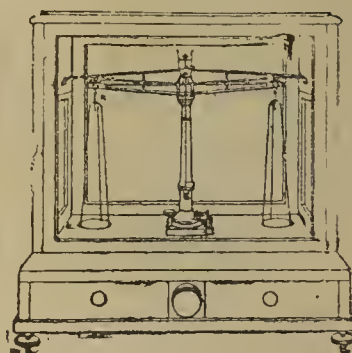
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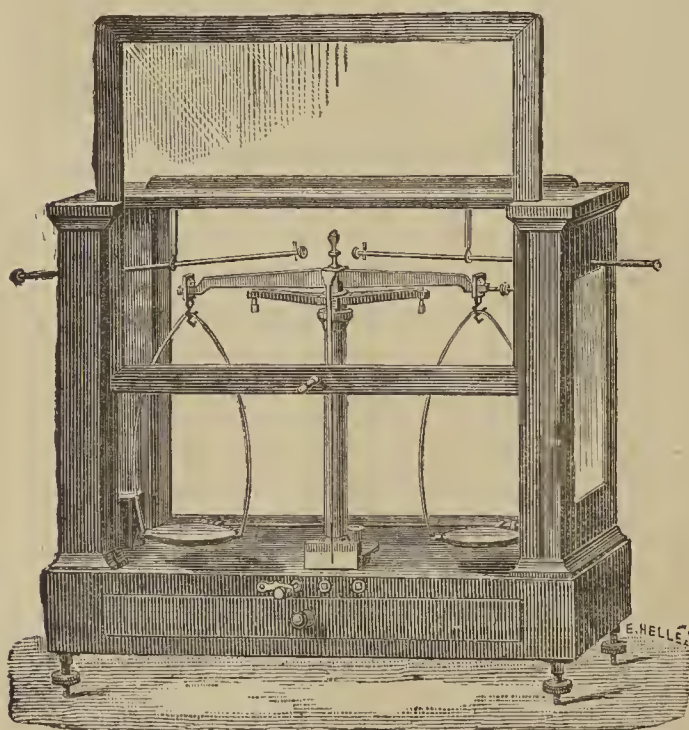
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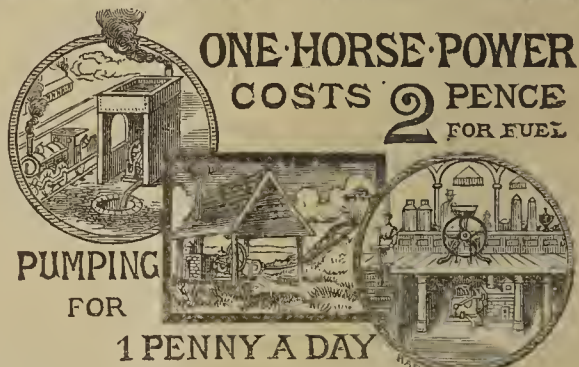
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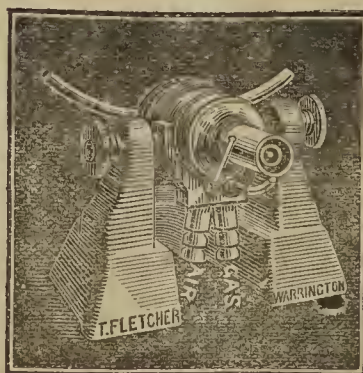
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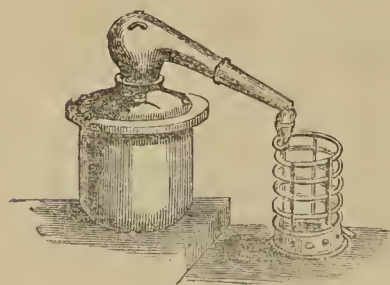
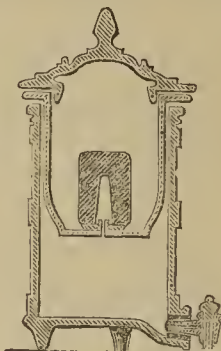
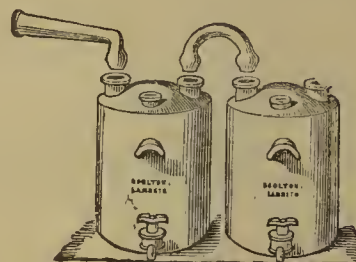
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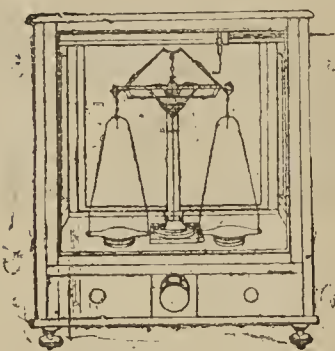
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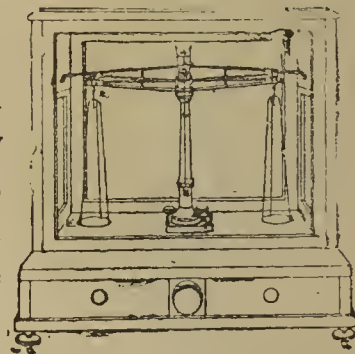
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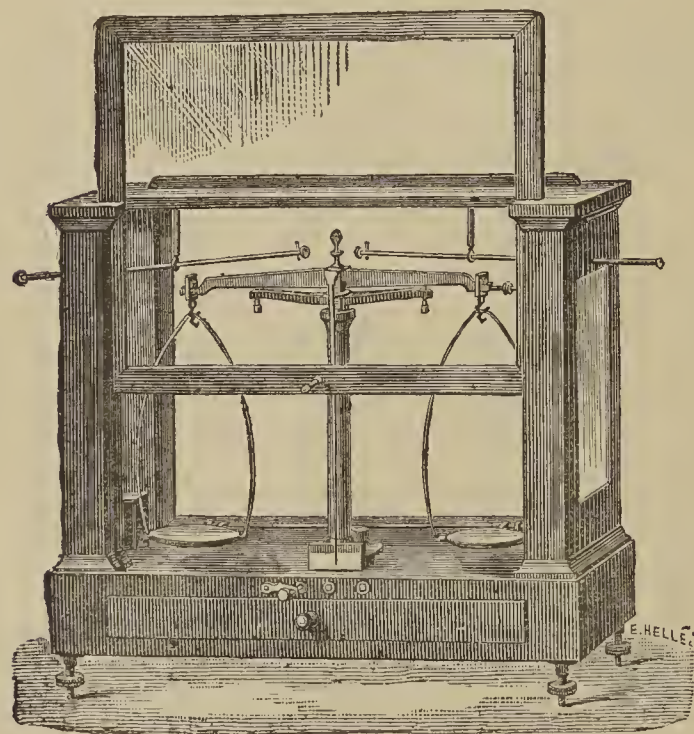
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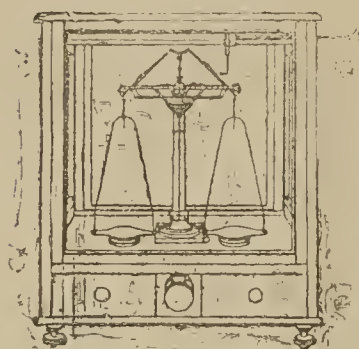
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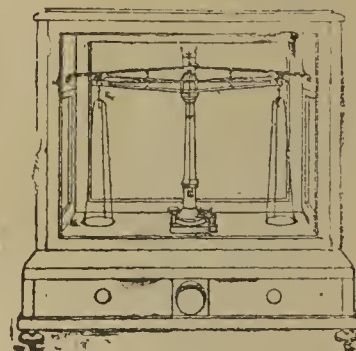
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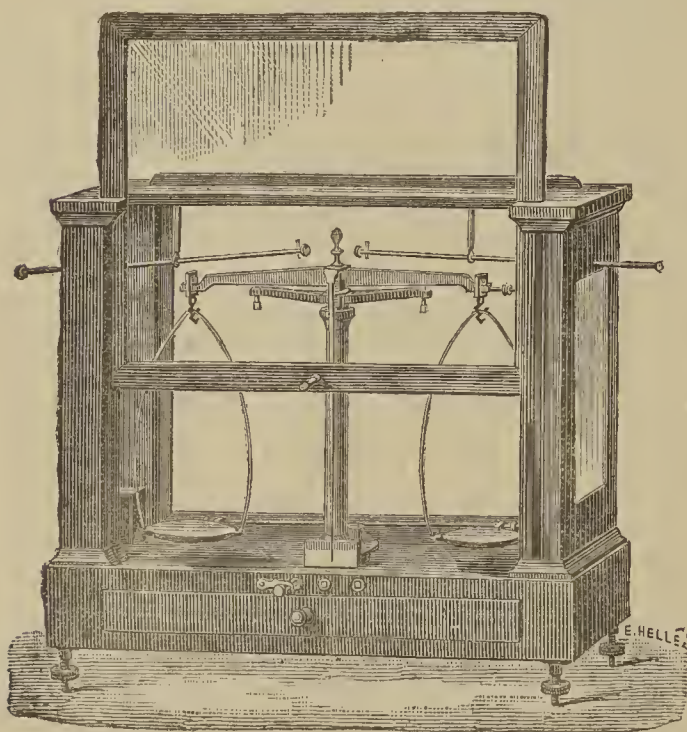
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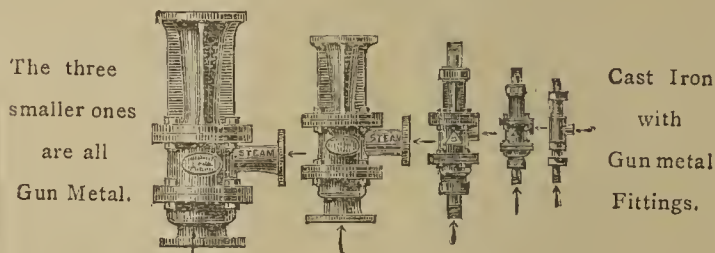
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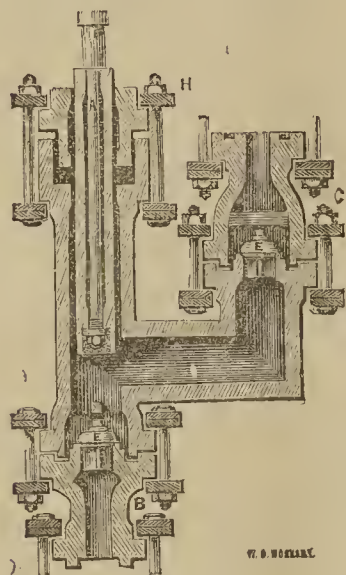
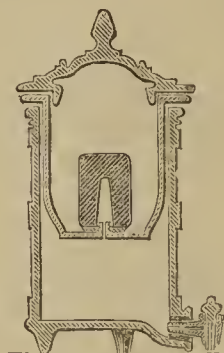
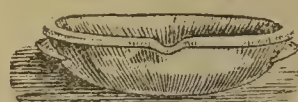
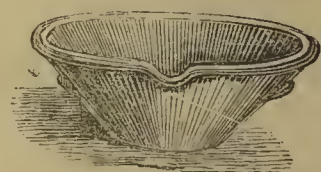
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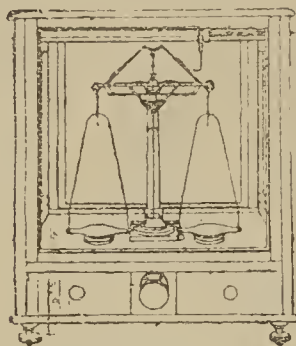
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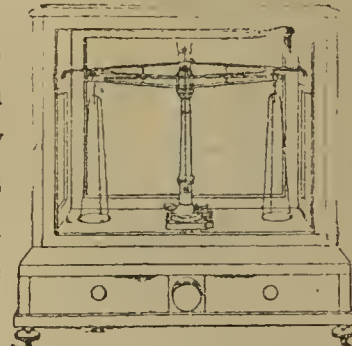
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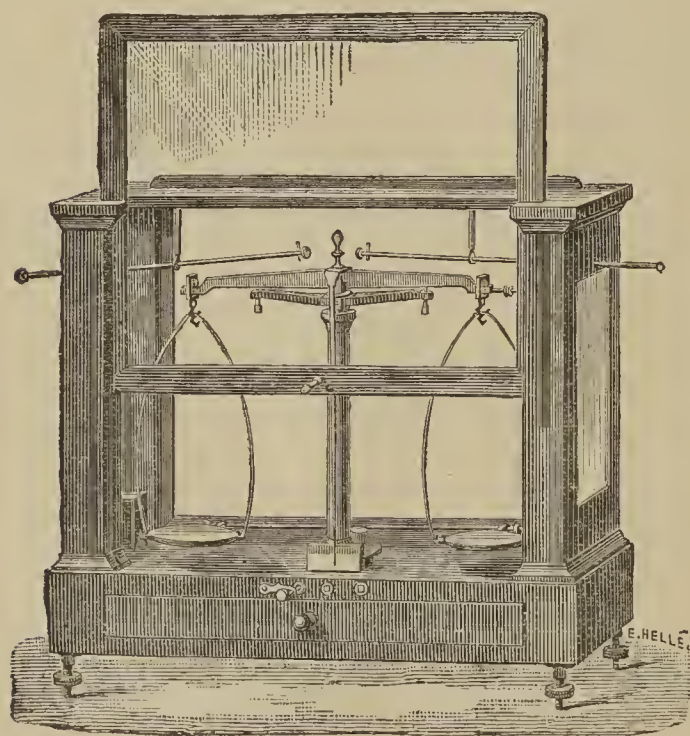
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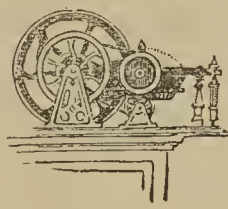
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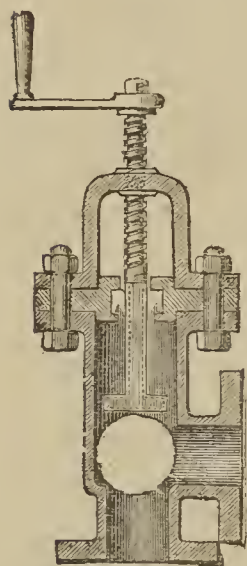
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The Gas Committee are prepared to receive
TENDERS for the purchase of the GAS TAR to be produced
at their Gaythorn Works, during a period of one or more years,
commencing on the 1st day of March, 1884. Sealed Tenders,
addressed to the Chairman of the Gas Committee, Town Hall,
Manchester, and endorsed "Tender for Gas Tar," must be delivered
here on or before Tuesday, the 15th day of May next. The Com-
mittee do not bind themselves to accept the highest or any tender.—
Further particulars and forms of tender may be obtained on applica-
tion to Mr Geo. B. JACKSON, at the Gas Office.—By order,

JOS. HERON, Town Clerk.

Town Hall, Manchester,
6th April, 1883.

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Further particulars may be obtained on application to the Com-
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Gas Office, Roodee, Chester, April 19, 1883.

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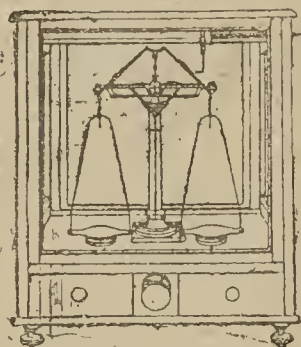
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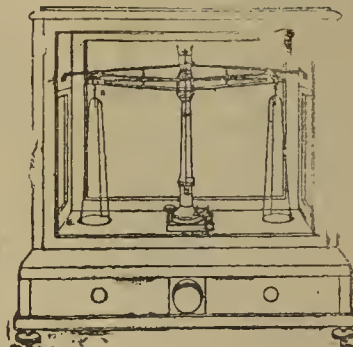
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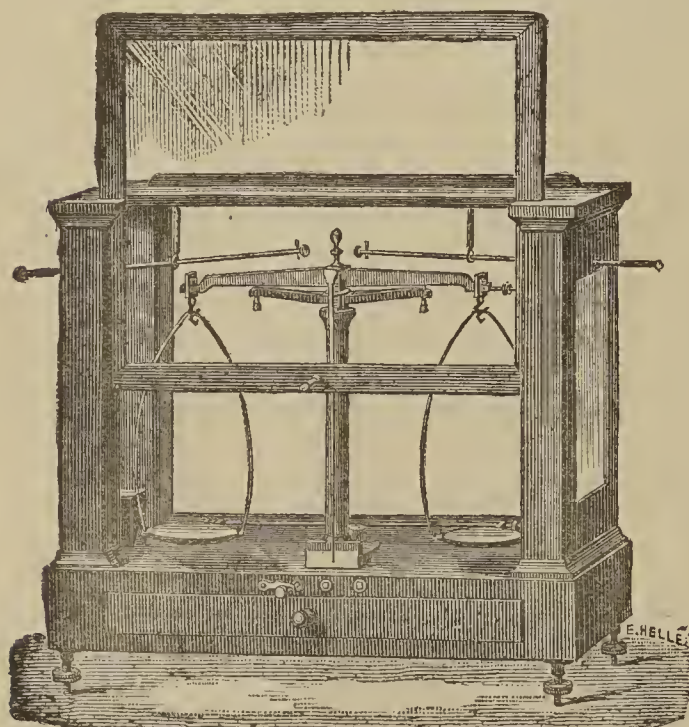
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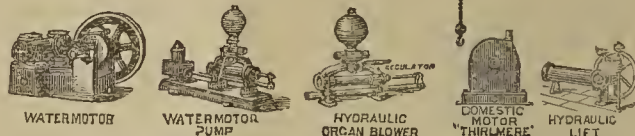
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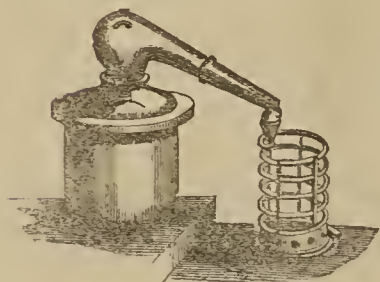
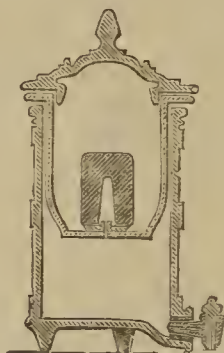
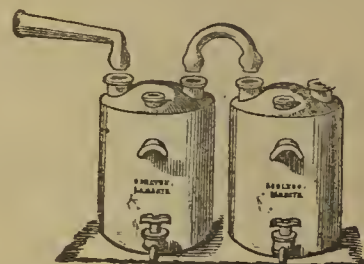
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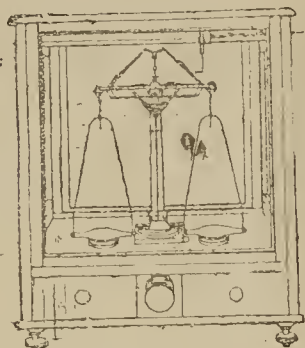
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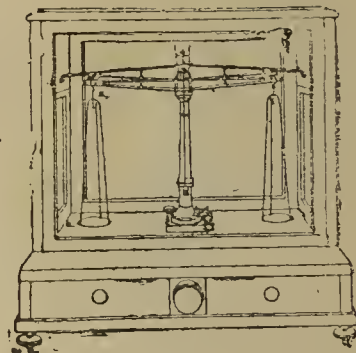
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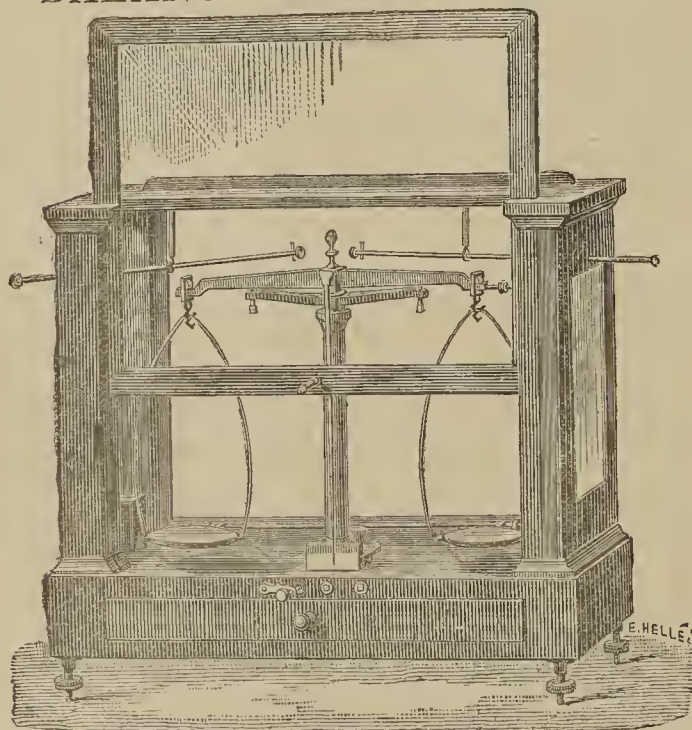
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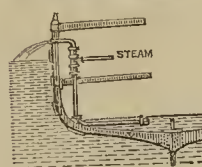
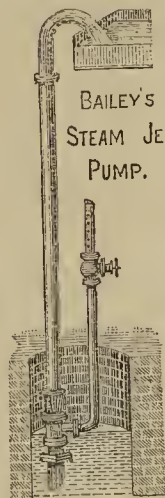
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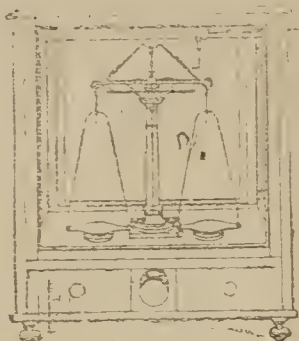
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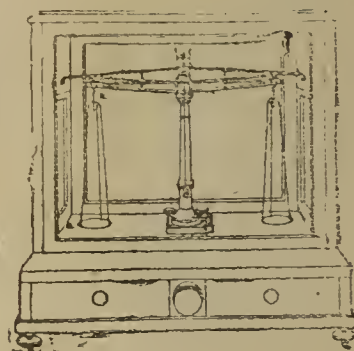
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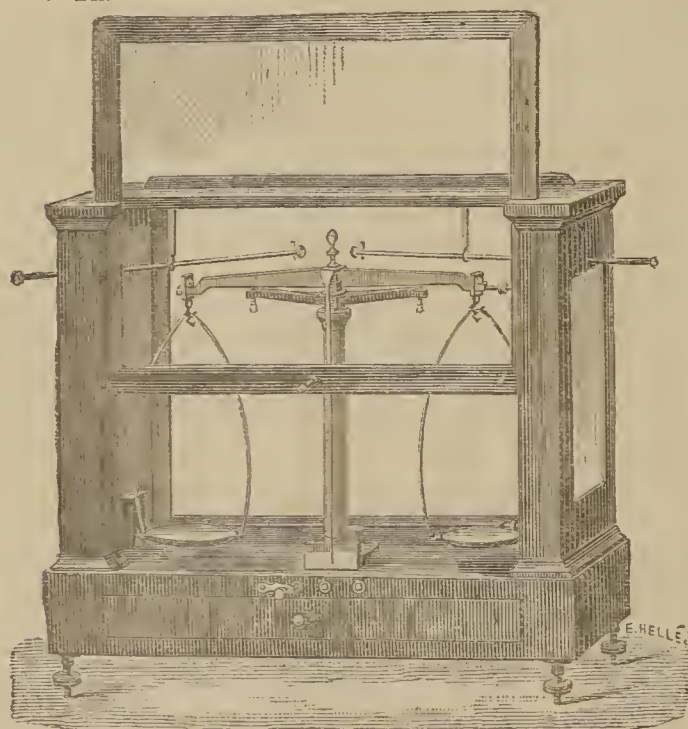
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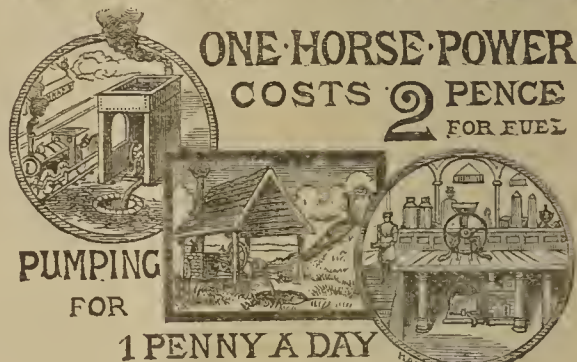
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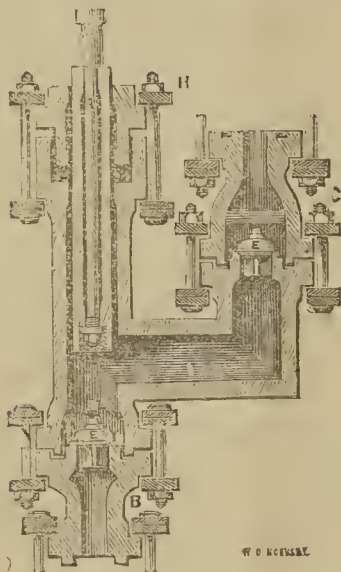
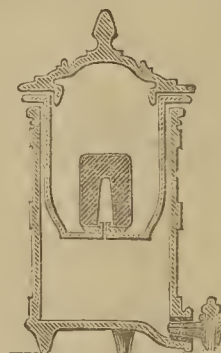
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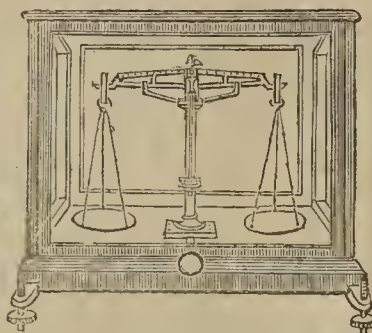
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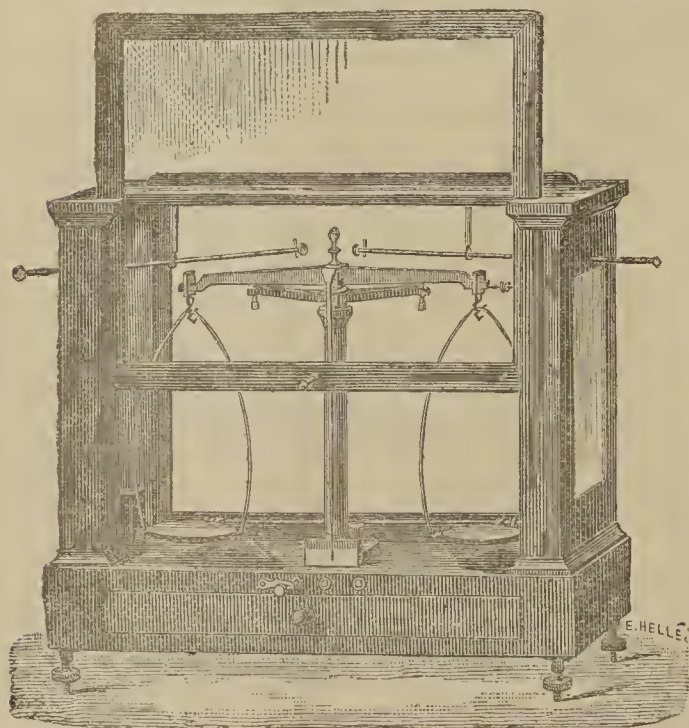
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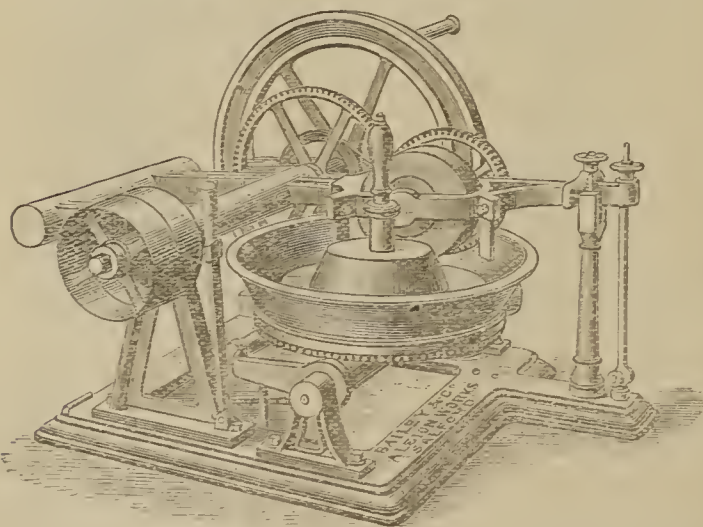
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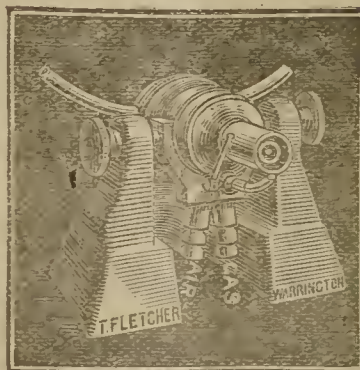
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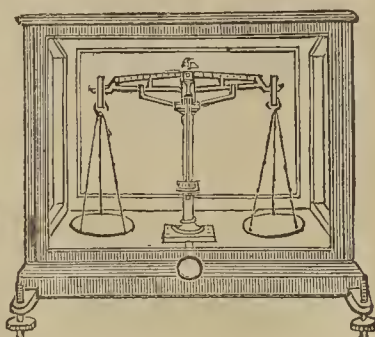
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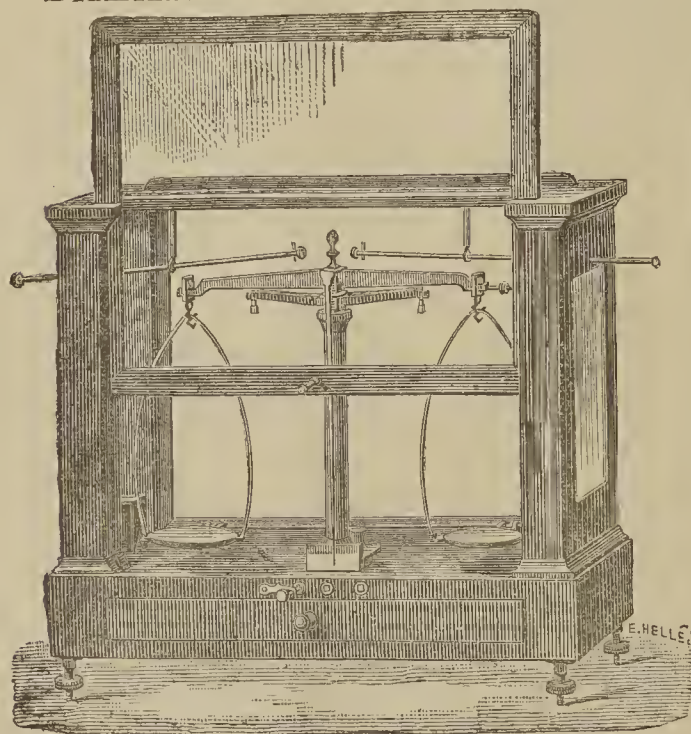
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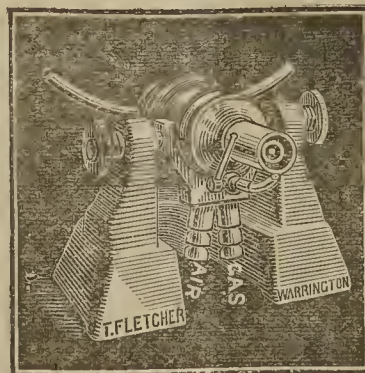
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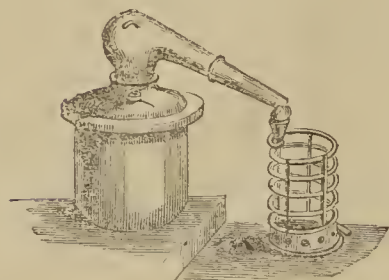
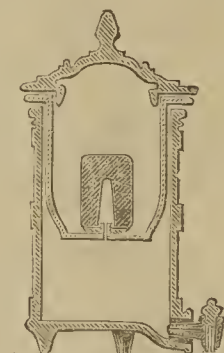
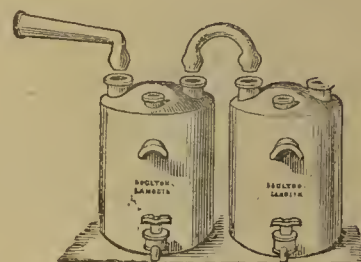
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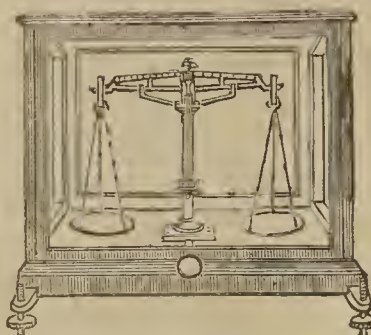
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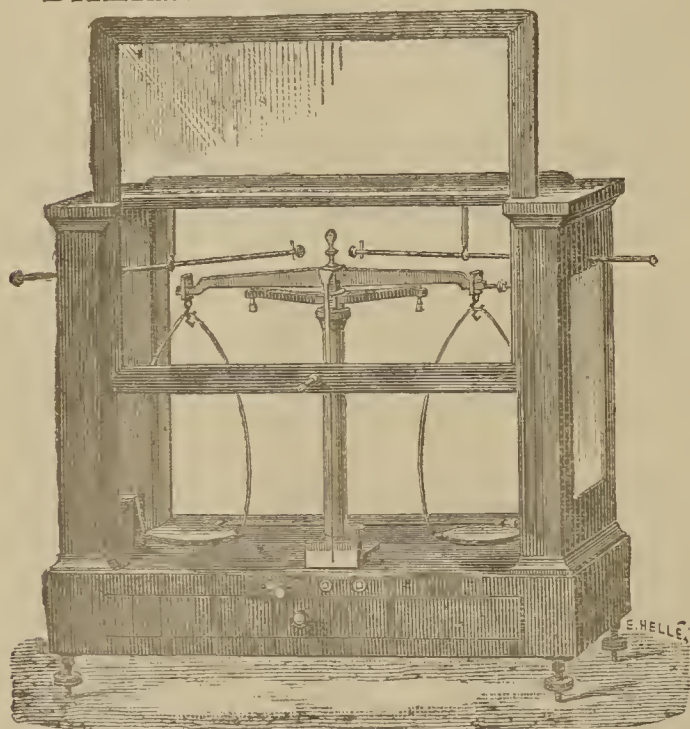
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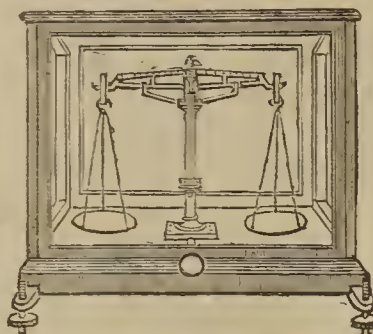
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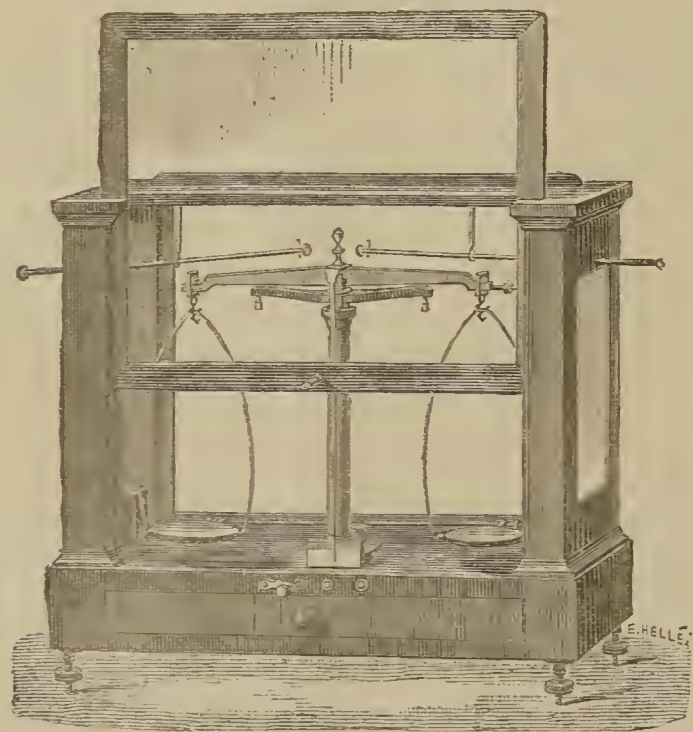
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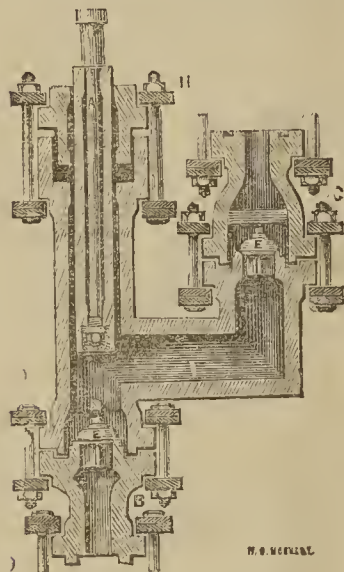
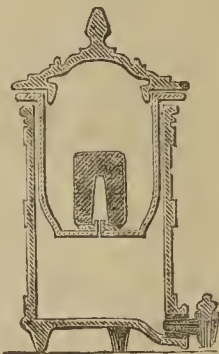
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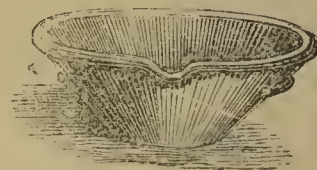
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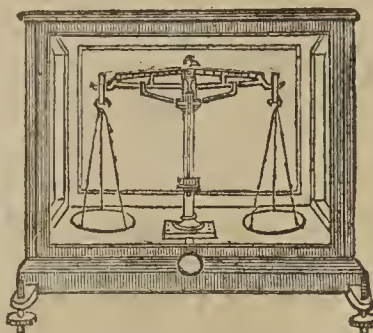
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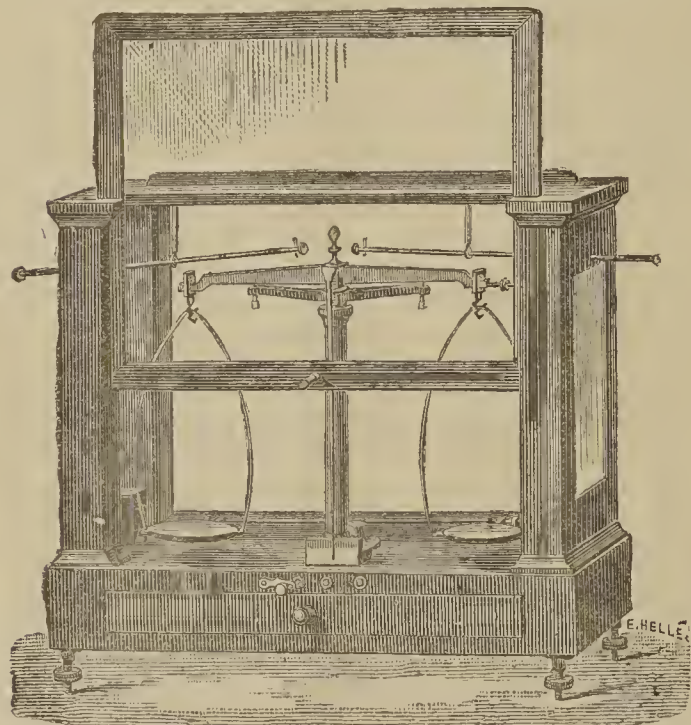
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THE CHEMICAL NEWS.

VOLUME XLVII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 1206.—JANUARY 5, 1883.

ON THE DARK PLANE WHICH IS FORMED OVER A HEATED WIRE IN DUSTY AIR.*

By Lord RAYLEIGH, F.R.S.

Professor of Experimental Physics in the University of Cambridge.

IN the course of his examination of atmospheric dust as rendered evident by a convergent beam from the electric arc, Professor Tyndall noticed the formation of streams of dust-free air rising from the summits of moderately heated solid bodies.† “To study this effect a platinum wire was stretched across the beam, the two ends of the wire being connected with the two poles of a galvanic battery. To regulate the strength of the current a rheostat was placed in the circuit. Beginning with a feeble current, the temperature of the wire was gradually augmented; but before it reached the heat of ignition, a flat stream of air rose from it, which, when looked at edgewise, appeared darker and sharper than one of the blackest lines of Fraunhofer in the solar spectrum. Right and left of this dark vertical band the floating matter rose upwards, bounding definitely the non-luminous stream of air.” . . .

“When the wire is white hot, it sends up a band of intense darkness. This, I say, is due to the *destruction* of the floating matter. But even when its temperature does not exceed that of boiling water, the wire produces a dark ascending current. This, I say, is due to the *distribution* of the floating matter. Imagine the wire clasped by the mote-filled air. My idea is that it heats the air and lightens it, without in the same degree lightening the floating matter. The tendency, therefore, is to start a current of clean air through the mote-filled air. Figure the motion of the air all round the wire. Looking at its transverse section, we should see the air at the bottom of the wire bending round it right and left in two branch currents, ascending its sides, and turning to fill the partial vacuum created above the wire. Now as each new supply of air, filled with its motes, comes in contact with the hot wire, the clean air, as just stated, is first started through the inert motes. They are dragged after it, but there is a fringe of cleansed air in advance of the motes. The two purified fringes of the two branch currents unite above the wire, and keeping the motes that once belonged to them right and left, they form by their union the dark band observed in the experiment. This process is incessant. Always the moment the mote-filled air touches the wire, the distribution is effected, a permanent dark band being thus produced. Could the air and the particles under the wire pass *through* its mass, we should have a vertical current of particles, but no dark band. For here, though the motes would be left behind at starting,

they would hotly follow the ascending current, and thus abolish the darkness.”

Professor Frankland,* on the other hand, considers that what is proved by the above described observations is that “a very large proportion of the suspended particles in the London atmosphere consists of water and other volatile liquid or solid matter.”

Last summer (1881) I repeated and extended Tyndall's beautiful experiment, not feeling satisfied with the explanation of the dark plane given by the discoverer. Too much stress, it appeared to me, is placed upon the relative lighting of the air by heat. The original density is probably not more than about $\frac{1}{1000}$ part of that of the particles, and it is difficult to see how a slight further lightening could produce so much effect. In other respects, too, the explanation was not clear to me. At the same time I was not prepared to accept Professor Frankland's view that the foreign matter is volatilised.



The atmosphere of smoke was formed within a box (of about the size of a cigar-box), three of the vertical sides of which were composed of plates of glass. A beam of sunlight reflected into the darkened room from a heliostat was rendered convergent by a large lens of somewhat long focus, and made to pass in its concentrated condition through the box. The third glass side allowed the observer to see what was going on inside. It could be removed when desired so as to facilitate the introduction of smoke. The advantages of the box are twofold. With its aid much thicker smoke may be used than would be convenient in an open room, and it is more easy to avoid draughts which interfere greatly with the regularity of the phenomena to be observed. Smouldering brown paper was generally used to produce the smoke, but other substances, such as sulphur and phosphorus, have been tried. The experiment was not commenced until the smoke was completely formed, and had come nearly to rest. In some respects the most striking results were obtained from a copper blade, about $\frac{1}{4}$ -inch broad, formed by hammering flat one end of a stout copper rod. The plane of the blade was horizontal, and its length was in the line of sight. The unhammered end of the rod projected from

* A Paper read before the Royal Society Dec. 21, 1882.

† *Proc. Roy. Soc.*, vol. 6, p. 3, 1870.

the box, and could be warmed with a spirit-lamp. The dark plane was well developed. At a moderate distance above the blade it is narrow, sometimes so narrow as almost to render necessary a magnifying glass; but below, where it attaches itself to the blade, it widens out to the full width, as shown in the figure. Whether the heated body be a thin blade or a cylindrical rod, the fluid passes round the obstacle according to the electrical law of flow, the stream-lines in the rear of the obstacle being of the same form as in front of it. This peculiarity of behaviour is due to the origin of the motion being at the obstacle itself, especially at its hinder surface. If a stream be formed by other means, and impinge upon the same obstacles without a difference of temperature, the motion is of a different character altogether, and eddies are formed in the shadow.

The difference of temperature necessary to initiate these motions with this dark plane accompaniment is insignificant. On July 20, 1881, a glass rod, about $\frac{1}{4}$ -inch in diameter, was employed. It was heated in a spirit-lamp, and then inserted in the smoke-box. The dark plane gradually became thinner as the rod cooled, but could be followed with a magnifier for a long time. While it was still quite distinct the experiment was stopped, and on opening the box the glass rod was found to be scarcely warmer than the fingers. It was almost impossible to believe that the smoking matter had been evaporated.

In order to test the matter more closely, smoke was slowly forced through a glass tube heated near the end pretty strongly by a spirit-lamp, and then allowed to emerge into the concentrated sunshine. No distinct attenuation of the smoke could be detected even under this treatment.

It is not necessary to dwell further upon these considerations, as the question may be regarded as settled by a decisive experiment tried a few days later. The glass rod before use was cooled in a mixture of salt and ice, and after wiping was placed in the box. In a short time a dark plane, extending *downwards* from the rod, clearly developed itself and persisted for a long while. This result not merely shows that the dark plane is not due to evaporation, but also excludes any explanation depending upon an augmentation in the difference of densities of fluid and foreign matter.

The experiment was varied by using a U-tube, through which cooled water could be made to flow. When the water was not very cold, the appearances were much the same as with the solid rod; but when, by means of salt and ice, the tube was cooled still further, a curious complication presented itself. Along the borders of the dark plane the smoke appeared considerably brighter than elsewhere. Sometimes when the flow was not very regular it looked at first as if the dark plane had been replaced by a bright one, but on closer examination the dark plane could be detected inside. There seems no doubt but that the effect is caused by condensation of moisture upon the smoke, due to the chilling which the damp air undergoes in passing close to the cold obstacle. Where the fog forms more light is scattered, hence the increased brightness. That the fog should not form within the smoke-free plane itself is what we might expect from the interesting observations of Aitken.

With respect to the cause of the formation of the dark plane, the most natural view would seem to be that the relatively dense particles are thrown outwards, by centrifugal force as the mixture flows in curved lines round the obstacle. Even when the fluid is at rest, a gradual subsidence must take place under the action of gravity; but this effect could at first only manifest itself at the top where the upper boundary of the gas prevents the entrance of more dust from above. It is known that air in a closed space will gradually free itself from dust, but the observation of a thin dust-free stratum at the top of the vessel is difficult. If we conceive a vessel full of dusty air to be set into rapid rotation, the dust might be expected to pass outwards in all directions from the axis, along which a

dust-free line would form itself. I have tried this experiment, but looking along the axis through the glass top of the vessel I could see no sign of a dark line, so long as the rotation was uniform. When, however, the vessel was stopped, a column of comparatively smoke-free air developed itself along the axis. This I attributed to the formation of an inward flow along the top of the vessel, combined with a downward flow along the axis after the manner described and explained by Professor James Thomson, so that the purified air had been in intimate proximity with the solid cover. It would almost seem as if this kind of contact was sufficient to purify the air without the aid of centrifugal force.

The experiments made hitherto in order to elucidate this portion have given no decisive result. If the thin convex blade already spoken of be held in the smoke-box in a vertical instead of in a horizontal plane, the lines of motion are much less curved, and we might expect to eliminate the influence of centrifugal force. I have not succeeded in this way in getting rid of the dark plane; but since under the magnifier the curvature of the motion was still quite apparent, no absolute conclusion can be drawn.

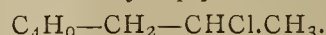
ON THE NORMAL PARAFFINS.*

(PART IV.)

By C. SCHORLEMMER, F.R.S., and T. E. THORPE, F.R.S.

THIS communication contains the results of an inquiry made to determine the constitution of the heptane which one of them found in the resinous exudation from *Pinus Sabiniana*. The pure heptane was converted into a mixture of chlorides, and these were transformed into the corresponding primary and secondary alcohols. The alcohol was then oxidised, and from the analysis of the silver salts it was proved that *Pinus* heptane had yielded primary heptyl alcohol and methyl-pentyl-carbinol, exactly as in the case of heptane from petroleum.

A second portion of the chlorides was converted into heptylene, boiling at 98.5° , which, unlike the heptylene of analogous constitution, combines only slowly with hydrochloric acid. The heptylene by oxidation was shown to be *butyl-methyl-ethylene*, $C_4H_9CH=CH.CH_3$; it had been formed from the secondary heptyl chloride—

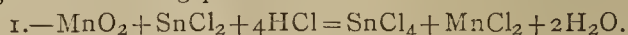


The results of the investigation afford further evidence of the fact that when chlorine acts upon a normal paraffin, not all the chlorides indicated by theory are formed, but only the primary chloride, and a secondary chloride, which contains the group— $CHCl.CH_3$.

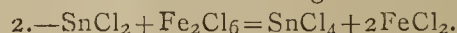
NEW PROCESS FOR THE RAPID VOLUMETRIC DETERMINATION OF BINOXIDE OF MANGANESE.

By J. W. CHALMERS HARVEY.

THE basis of this process consists in heating the sample containing the binoxide with an excess of a solution of stannous chloride and some hydrochloric acid, the following reaction taking place:—



By now adding ferric chloride in excess, all the excess of stannous is oxidised to stannic chloride, a corresponding amount of ferrous chloride being formed thus:—



The iron thus deoxidised is then estimated by a standard solution of potassium bichromate.

* Abstract of a Paper read before the Royal Society, Dec. 27, 1882.

In the first equation one molecule (87 parts) binoxide of manganese converts one molecule stannous into stannic chloride.

In the second equation one molecule ferric chloride (containing 112 parts iron) oxidises the same quantity of stannous into stannic chloride; therefore 112 parts iron, by their conversion from the ferric to the ferrous condition, correspond in oxidising power to 87 parts binoxide of manganese.

Now if we take two measured quantities of stannous chloride, mix the one directly with excess of ferric chloride, heat gently, and then determine the iron reduced to ferrous chloride, by standard bichromate of potash; then add to the second portion of stannous chloride the binoxide, hydrochloric acid, and heat, then when the binoxide has disappeared, add ferric chloride also in excess, and lastly, determine the iron existing in protoxide; the difference between the iron deoxidised in the former and that deoxidised in the latter case will be due to the conversion of a corresponding amount of stannous into stannic chloride by the binoxide of manganese in the sample.

For example, say the difference, when multiplied up to the percentage = 80 per cent iron, then if—

Iron. MnO_2 . Iron.

112 : 87 :: 80 = x = 62.1 per cent MnO_2 .

Requisites:—Standard Bichromate of Potash.—Dissolve 30 grms. pure bichromate of potash in water and make up to 2 litres; 1 c.c. = 0.017 gm. iron = 0.013205 gm. binoxide of manganese.

Solution of Stannous Chloride.—Dissolve 180 grms. in hydrochloric acid with the aid of heat, and when the solution becomes clear make up with water to 1 litre.

Solution of Ferric Chloride.—Make this by dissolving about 60 grms. iron wire, or (as pure as obtainable) red hematite corresponding to this amount of iron, the former in hydrochloric acid, oxidising with potassic chlorate and boiling off excess of chlorine, the latter in hydrochloric acid, and making the solution up to 1 litre. The solution is conveniently added from a burette.

Conduct of Process.

Weigh out 1 gm. of the finely powdered binoxide, add to it 10 c.c. stannous chloride, about 15 c.c. hydrochloric acid, and heat until all the binoxide is dissolved, now add ferric chloride in excess and again heat for a short time to promote the action of the stannous chloride on the ferric chloride; lastly, estimate the ferrous chloride formed by the bichromate.

10 c.c. of stannous chloride are now heated with excess of ferric chloride and then titrated with bichromate until all the ferrous is converted into ferric chloride. The difference between the number of c.c. used in the latter and in the former case multiplied on the value of each c.c. gives the binoxide in 1 gm. and this by 100 the percentage. It is advisable to estimate the number of c.c. of standard bichromate corresponding to the 10 c.c. (or any other quantity of stannous chloride solution which may be used in the process) before each series of experiments, if any time elapses between them, as the stannous chloride (as is well known) is liable to change.

The whole time required for an assay occupies not more than fifteen minutes.

To test the foregoing process manganous sulphate was dissolved in water, precipitated when boiling with carbonate of soda, the manganous carbonate collected on a filter, dried, and the precipitate then separated from the filter-paper and heated in a muffle for several hours to convert the carbonate into proto-sesquioxide of manganese. This when tested by Fresenius and Will's process gave a result of 36.64 per cent MnO_2 instead of 38 per cent, which, theoretically, it ought to contain—

Fresenius and Will's Process.

36.64 per cent.

—

—

Above Process.

36.71 per cent.

36.84 „

36.71 „

A sample of commercial binoxide was then tested with the following results.

Fresenius and Will's Process.

56.23 per cent.

—

—

1st determination

2nd „

3rd „

Mean

Above Process.

56.52 per cent.

56.52 „

56.64 „

56.56 „

Another sample of commercial binoxide was tested.

Fresenius and Will's Process.

60.50 per cent.

—

—

1st determination

2nd „

3rd „

Mean

Above Process.

60.08 per cent.

60.34 „

60.34 „

60.28 „

The process above recommended might also be applied to determine the available chlorine in bleaching-powder.

Instead of proceeding as above the excess of stannous chloride might also be estimated accurately (I should be inclined to think) by a standard solution of ferric chloride.

Experiment in this direction, however, would be necessary to settle this point.

Chemical Laboratory,
Maryport Iron Works,
Dec. 29, 1882.

SEPARATION OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

Separation from Bismuth.—Three methods are to be recommended:—

1. The distinctly acid hydrochloric solution is saturated with hydrogen sulphide. All the bismuth is obtained as sulphide, which retains no gallium. The operation succeeds even when the liquid has been rendered turbid by a previous dilution.

2. The bismuth may be reduced by zinc in a solution which is kept distinctly acid, but it is better to use copper which does not introduce impurities like zinc, and the ulterior separation of which from gallium is easy. The acid hydrochloric solution is treated for 12 to 80 hours with an excess of finely divided copper. The liquid is kept at a gentle heat all the time, which hastens the deposition of the bismuth. We find no bismuth in the liquid nor gallium in the deposit (or scarcely a slight trace). The formation of insoluble cuprous chloride is not an inconvenience.

3. In a solution containing one-third of its volume of concentrated hydrochloric acid, and in presence of bismuth, gallium chloride is precipitated by potassium ferrocyanide, either in the cold, or at 60 to 70°. The gallium ferrocyanide, well washed with hydrochloric water, retains no bismuth. It is to be remarked that, contrary to the statements of the chemical text-books, the precipitate formed by ferrocyanide with bismuth chloride is readily soluble in hydrochloric acid, even if dilute.

Boiling potassa does not effect the exact separation of gallium from bismuth. The precipitated oxide is free from gallium, but the alkaline liquid retains a notable quantity of bismuth. It is generally, but erroneously, assumed that in analyses bismuth oxide is completely precipitated by potassa.

Separation from Copper.—According to circumstances we may choose among the four following methods, all of which are good, but the first is to be preferred whenever applicable.

1. The hydrochloric solution, distinctly acid, is treated with a current of hydrogen sulphide. The copper sulphide is then treated with acidulated water containing hydrogen sulphide.

2. On ebullition, kept up for some minutes, potassa

throws down anhydrous cupric oxide containing no gallium. The separation is good.

3. In a solution kept slightly acid zinc easily throws down the copper without carrying the gallium along with it. It is much better to reduce the copper by means of the electrolysis of a sulphuric solution, quite free from chloride. The operation is performed in a platinum vessel, taking the precautions which the author gave for the electrolytic determination of copper. (*Bulletin de la Soc. Chimique*, 1867, first half year, p. 468, and 1869, first half year, p. 35).

4. The separation may be effected by the prolonged boiling of a solution supersaturated with ammonia, provided that the copper is not very abundant, in which case the operation has to be several times repeated. The original hydrochloric solution must be very acid in order that it may afterwards contain a notable quantity of ammonium chloride.

Separation from Mercury.—Of the three following methods the first must be especially recommended as exact and rapid.

1. The hydrochloric solution, distinctly acid, is treated with an excess of hydrogen sulphide.

2. The mercury may be reduced by zinc, or preferably by copper, in a liquid kept slightly acid. The reduction of mercury is more rapid than that of bismuth; it is complete, and the precipitate contains no gallium. The formation of a deposit of cuprous chloride is not an inconvenience.

3. Potassium ferrocyanide may be used for the separation of gallium from mercury in a very acid solution. The precipitate, if carefully washed with hydrochloric water, retains no mercury.

Chemical treatises generally teach that the precipitate formed by potassa in mercuric salts is insoluble in an excess of the reagent. Nevertheless, potassa cannot serve for the separation of gallium from mercury, since the alkaline liquid retains notable quantities of mercury. That part of the mercuric oxide which is precipitated on boiling is free from gallium.—*Comptes Rendus*, Dec. 11, 1882.

ON THE ATOMIC WEIGHT OF YTTRIUM.

By M. P. T. CLEVE.

In 1872 I determined the atomic weight of yttrium by the synthesis of the sulphate from yttria, the purest which I had been able to obtain at that time, by the partial decomposition of the nitrates. At that time we had no knowledge of terbia, an earth without an absorption-spectrum and having a higher molecular weight. As a proof of the purity of the yttrium oxide we depended then on the absence of the absorption-rays, which, since the discovery of terbium, is no longer sufficient. It has therefore been necessary to undertake afresh the determination of the atomic weight of yttrium.

The separation of terbia from yttria is very difficult and requires much time, whilst the yield of pure yttria is very small. The decomposition of the nitrates does not give good results. On the other hand, we cannot avail ourselves of potassium sulphate, or of hydrocyanic acid for the elimination of small quantities of terbia in yttria, though those reagents are useful for the separation of small quantities of yttria in terbia. The only method available is to precipitate an acid solution of the nitrate with oxalic acid, and to determine the atomic weight of the successive fractions.

By this method I finally succeeded in obtaining 3 to 4 grms. of yttria, the molecular weight of which was constant. The percentage proportion of Y_2O_3 in the sulphate was, in four fractions, 48.507, 48.526, 48.497, 48.494. The discrepancies are slight, and fall quite within the limits of experimental error. With this small quantity of yttria

I made eight more determinations, in all twelve. I obtained—

Maximum of Y_2O_3 in 100 sulphate	..	48.526
Minimum .. .. .	..	48.483
Mean of twelve determinations	..	48.503
± 0.00029 .		

From this mean we may calculate the atomic weight of $Y''' = 89.02$ if $O=16$ and $S=32$; or 88.9 if $O=15.9633$ (± 0.0035) and $S=31.984$ (± 0.012).

My determinations in 1872 showed 48.605 (± 0.0096) for 100 Y_2O_3 in the sulphate, and for the atomic weight 89.485 .

Pure yttria is perfectly white; the yellow colour which it sometimes has is due to the presence of a trace of terbia.—*Comptes Rendus*, Dec. 11, 1882.

PYROLOGICAL NOTES.

By Lieut.-Colonel W. A. ROSS, late R.A.

(Continued from vol. xlvi., p. 283)

VIII. BORIC ACID AND ALUMINIUM PLATE (*Continued*).

SOME able chemists have made extraordinary efforts to reduce borax blowpipe chemistry to a system, but all in vain: they have generally had to assume or suppose that borates of uranium, magnesium, zirconium, and what not, "crystallise out" of the saturated borax bead *per se* on "flaming" or other treatment with the blowpipe; the fact, which can be easily proved, by means of boric acid, being that pyroborates of sodium or potassium can be displaced by no other base whatever, before the blowpipe. If, therefore, they would only be persuaded to bring the noble science of chemistry to bear upon the reactions of indubitable "borates"—such as that formed by the application of pure lime to pure boracic acid B.B.—they would soon make immense strides in the prosecution of pyrology or blowpipe chemistry, in advance of such compilations and imitations from Plattner and Von Kobell as we see produced in the present day. For instance, the application of microscopy and spectroscopy to the "inner balls" referred to lately in the *CHEMICAL NEWS* (vol. xlvi., p. 273) of itself opens up an immense and entirely untrodden field of investigation, obviously suited to advanced microscopical research.

The Analytical Capabilities of Aluminium Plate.

In the Manchester "translation" of the second edition of a German work on blowpipe analysis, the translators say—"the incrustations are thicker on aluminium plate than on charcoal, because the support does not become so strongly heated." This statement seems to me erroneous; and I shall therefore, with your permission, explain what I conceive to be the *rationale* of the action of aluminium plate, in proving my assertion.

The part of a stick of charcoal support where "incrustations" are deposited, is *infinitely cooler* than any part of the aluminium plate, for the simple reason that charcoal is an almost perfect non-conductor, whilst aluminium is the most rapid heat-conductor of any known metal, in consequence of which it is necessary to hold it by means of a pair of muffled forceps. On account of this very rapidity of heat-conduction of aluminium plate, most sublimates deposited upon it can be further treated by the "oxidising and reducing flames" of the blowpipe, affording various characteristic reactions therein, because the heat being so rapidly carried away by this support beneath the coating or sublimate, and thus withdrawn from it, cannot, evidently, be so concentrated on the sublimate itself as in the case of the feebly conducting charcoal; in consequence of which most sublimates are not volatilised again, or re-sublimed by the blowpipe, as nearly all sublimates are when deposited and treated upon a charcoal support.

There is no proof, however, that sublimate is "thicker" upon aluminium than upon cold charcoal; nor indeed, is it easy to perceive in what way such a fact would constitute an advantage. Thus, in Prof. Cornwall's words, the arsenical coating is "very volatile;" the antimonial coating "easily volatile," &c.; when treated by the blowpipe upon charcoal, whilst, in the case of those sublimate deposited together upon aluminium plate, O.P. instantly volatilises the volatile arsenical sublimate, and blackens the fixed antimonial one.

It is not by any means asserted that the above fact constitutes the greatest advantage of using aluminium plate as a support; for instance, the capability of treating a compound of antimony, lead, and copper, such as *Bournonite*, upon the bare plate first, when the antimony is eliminated, then upon a charcoal lozenge, or "slip," as Hutchings called it, when lead can be all sublimed, leaving the copper behind, seems to me a still greater advantage; but I merely venture to offer this explanation, in order to show that the *rationale* of the action of aluminium plate before the blowpipe as given by me in "Pyrology" in 1875, remains unshaken by statements in those text-books which have taken up the subject.

In conclusion, I beg to protest against the modern use of the word "incrustation," applied to these sublimate in some of these text-books. I call rust an incrustation, and suppose in the first place that that phrase implies a moderately hard, not an extremely soft, substance; and secondly, that it has been formed (like rust) from within, and not deposited from without.

THE MANUFACTURE OF POTASH ALUM FROM FELSPAR.*

By HENRY PEMBERTON, Jr.

In the August number of the *Journal of the Franklin Institute* there is an article by John Spiller (first published in the *Journal of the Society of Chemical Industry*, Manchester, April, 1882), in which it is proposed to manufacture potash alum from felspar, by treatment with sulphuric acid and a fluoride, the latter being either fluor-spar or cryolite.

Felspar is a mineral occurring in immense deposits, and containing potash and alumina sufficient to give on a practical scale an amount of alum equal in weight to the quantity of felspar treated. It can be had, under favourable circumstances, at a cost not exceeding a few dollars per ton. The fluor-spar is equally cheap, and the sulphuric acid (as "chamber acid") is manufactured in this country at about 8 dols. a ton. The resulting alum finds a ready market at 40 to 45 dols. per ton, and the margin of profit, therefore, seems to be a very fair one.

I propose to show, however, that the above rosy view is a deceptive one, as far, at least, as the American market is concerned, and that the process is not only a technically difficult one, but will prove to be so expensive that the alum will cost about as much as it will bring.

Taking the typical felspar selected by the author, we have, as its composition—

Silica	..	..	..	..	..	..	65.00
Alumina	..	..	..	..	..	..	17.85
Potash	..	..	..	..	..	..	12.31
Iron, lime, magnesia, soda, &c., by difference	..	..	..	..	..	..	4.84

100.000

To volatilise the 65 per cent silica as tetrafluoride will require 169 parts of fluor-spar, supposing the latter to be chemically pure. We therefore will have the following

percentages of bases and acid employed in treating 100 parts of felspar:—

		Per cent SO ₃ .
17.85	per cent alumina, requiring	.. .. 42.00
12.31	" potash, "	.. .. 10.45
169.00	" fluor-spar, "	.. .. 173.33

Total SO₃ required = 225.78

This is equivalent to 443 parts of "chamber acid" containing 51 per cent anhydride. The acid for the small quantity of other bases present is here neglected.

The author finds it "necessary to get rid of the excess of sulphuric acid by thoroughly heating the decomposed mass in a current of air before dissolving." Any one familiar with the behaviour of alum at a high heat—especially when mixed with three times its weight of sulphate of lime—will fight shy of this operation on the large scale.

Mr. Spiller is perfectly right in asserting that there will be an excess of sulphuric acid in the decomposed mass, even when the quantity theoretically necessary is used. Experience has proved, in decomposing any solid material with acid in this manner, that from 10 to 15 per cent of the material escapes the action of the acid, a corresponding amount of acid also being left uncombined. The reason for this being that the quantity of already decomposed material acts as a diluent of, and a mechanical separator between, the remaining small quantities of acid and base. The most rational method of obviating this difficulty is to use a proportionally smaller quantity of acid. Charging the above formula, therefore, with only 85 per cent of the acid given, and assuming that the felspar, when mined, hauled, calcined (to render friable), ground and bolted, costs 5 dols. per ton, and the fluor-spar 3 dols. per ton, we have, as the cost of the ingredients—

	Dollars.
2000 lbs. felspar, at 5 dols.	.. .. 5.00
3380 " fluor-spar, at 3 dols.	.. .. 5.07
7531 " 50°B. acid, at 8 dols.	.. .. 30.12
	—————40.19

Labour for mixing, leaching, evaporating, crystallising, and packing, with coal for evaporating, at least	.. .. 5.00
Eight barrels, at 20 c.	.. .. 1.60

Yield = 2000 lbs. alum, costing 46.79

Or a little over 2½ c. per pound, not including general expenses, salaries, insurances, &c. This is just about the present market price for crystal alum.

It will be observed that the weak point in the above process is the quantity of acid required to liberate the fluorine from the fluor-spar, nearly 80 per cent of the acid charged being used for this purpose. About three tons of sulphate of lime, therefore, are formed, from this acid, for every ton of alum made. This bulky, insoluble, useless material, has to be leached to extract the alum, requiring much water, giving weak liquors, and, consequently, wasting much coal in the subsequent concentration.

Recognising these objections, Mr. Spiller proposes cryolite as the source of fluorine, in place of fluor-spar.

This is an idea, if possible, still more unfortunate than the former one. In the first place, cryolite is expensive—exceedingly expensive when compared with the other materials used. In the second place, it yields the wrong alkali—soda, in place of potash. And, thirdly, even if the necessary potash were added (from Stassfurt salts), the resulting Glauber's salt—formed from the soda—would be left as a white elephant upon the hands of the manufacturer; all the whiter from the fact that it is contaminated to the saturation point with potash alum.

It is proposed to pass the fluoride of silicon, evolved from the above decompositions, into water, and to sell the resulting silica and hydro-fluosilicic acid. As the alum industry is one amounting to hundreds of tons, whilst the

* A Paper read before the Chemical Section of the Franklin Institute, Sept. 5, 1882.

most that can be claimed for the silica (for polishing powder) is that it can be disposed of by the hundreds of pounds, the odds against the silica are as 2000 to 1. Still less can be said for the hydro-fluosilicic acid.

So it does not appear that there is much of value in Mr. Spiller's idea. It is true that this article was written for the English market. There the price for materials and labour is unquestionably lower than here. So also is the price the alum will bring. The argument against the process, therefore, will hold good in either longitude.—*Journal of the Franklin Institute.*

ANALYSIS OF HELVITE FROM VIRGINIA.*

By REUBEN HAINES.

THE writer was requested by Mr. Henry Carvill Lewis to analyse a mineral he had lately found among others at the mica mines, near Amelia Court House, Virginia, a locality which has become remarkable for its rare minerals. It appears to be Helvite, a rare mineral hitherto found only in Europe; in Saxony, Norway, and Finland. It is a silicate of glucina and manganese, containing ferrous sulphide and manganese sulphide. It occurs in yellow crystals and crystalline masses associated with orthoclase and garnet.

The following mineralogical determinations were made by Mr. Lewis. The crystals were shown by the polariscope to be isometric, but were not sufficiently perfect for angular measurement. Hardness about 6; colour sulphur-yellow; lustre somewhat resinous; partially translucent; fusibility about 4, with intumescence to a brown glass. The mineral gives no water in closed tube; with fluxes reacts for manganese; soluble in hydrochloric acid with evolution of hydrogen sulphide and separation of gelatinous silica.

The specific gravity which I determined myself was 4.306 (see correction in next column.)

The results of my analysis are as follows:—

Siliceous gangue	..	9.22	} 32.32 per cent.
SiO ₂ (gelatinous)	..	23.10	
BeO	.. .. .	11.47	
Al ₂ O ₃	.. .. .	2.68	
MnO	.. .. .	45.38	
FeO	.. .. .	1.85	
CaO	.. .. .	0.64	
K ₂ O	.. .. .	0.39	
Na ₂ O	.. .. .	0.92	
S	.. .. .	4.50	
Ignition (moisture)	..	0.30	

100.45

Less oxygen replaced by sulphur

2.25

98.20

The total amount of the mineral obtained was scarcely more than one gram. About 0.72 gram. was reserved for general analysis, and the remainder was used for determination of specific gravity, sulphur, and moisture.

The method of analysis pursued was as follows:—

The powdered mineral was dissolved in hydrochloric acid, evaporated to dryness, filtered, and the residue treated on the filter eight times with hot concentrated solution of sodium carbonate, and finally washed thoroughly with hot water. Ignition of the residue gave the siliceous gangue insoluble in acid and in sodium carbonate. There was thought to be less risk in washing on the filter than by boiling up in a beaker and re-filtering. The total silica plus gangue was obtained by weighing the residue of silica from the estimation of sulphur for

which about 1.5 gram. was used. The difference between these two estimations gave the gelatinous silica. The Fe₂O₃ and the Al₂O₃ were separated from MnO and BeO by first repeated precipitation by ammonia, and finally by protracted boiling with concentrated solution of ammoniac chloride repeated four or five times to dissolve out all the glucina (Berzelius's method). The Fe₂O₃ and Al₂O₃ were weighed together and titrated by permanganate in the usual way. The glucina and manganese were separated by double precipitation by ammonia, being careful to avoid excess, heating as short a time as possible and filtering soon to avoid re-solution of the glucina. The manganese was precipitated by bromine and then by sodium phosphate, and was weighed as pyrophosphate. The filtrate from the calcium oxalate, after testing for magnesia, was boiled with barium hydrate to obtain the alkalies, which were separated by platinum chloride, and the ignited platinum weighed.

The sulphur was separated and oxidised by dissolving the mineral in hydrochloric acid, to which bromine had been added.

For the specific gravity determination 0.28 gram. was used. It was made in a ten-gram. specific gravity bottle with great care as to temperature and all other necessary precautions.

The moisture was determined in a separate portion, the weight of which was 83 milligrams, by direct absorption in a chloride of calcium tube attached to a combustion furnace.

As regards the silica, it will be noticed that in former analyses the amount given is 33.26 to 35.27 per cent. in two analyses by Gmelin; 33.13 per cent. in one analysis by Rammelsberg, and 30.31 per cent. in one analysis by Teich. If the gangue and gelatinous silica in my analysis are added together we have total silica 32.32 per cent. It appears to me, however, that either we must regard the gelatinous silica alone as a legitimate part of the true species, and consider the "gangue" as accidental impurity, or we must consider the silica of the true mineral as existing in two distinct molecular conditions. The latter hypothesis is scarcely tenable, while the former would require a formula quite different from that given by Dana for Helvite.

CORRECTION TO THE ABOVE.*

SINCE the analysis of helvite from Amelia Court House, Va., was published (July, 1882), I have received from Mr. H. C. Lewis another sample of this mineral of much larger amount from the same locality. A re-examination of the specific gravity shows the previous determination to have been erroneous. It is now found to be 3.29. Dana gives the specific gravity as varying from 3.1 to 3.3. The error doubtless originated in attempting to work on too small a quantity of the mineral, less than three-tenths of a gram. having been used. For the determination now given 1.176 grms. were taken, and the same portion afterwards used for general analysis. The material was very carefully picked over several times under a magnifying lens, and only the larger and more uniformly yellow-coloured crystals selected. The largest of these, however, scarcely exceeded from one-twelfth to sixteenth of an inch in diameter. Mingled with the impure mineral sent me was a considerable amount of orthoclase felspar, to which some of the helvite adhered strongly, and also a number of crystals of pale-red topazolite (Lewis), a variety of garnets were observed mixed with the helvite, some adhering to the latter or partially imbedded in it.

A new analysis of the purified helvite gave total SiO₂, 32.49 per cent., of which the insoluble gangue was 5.17 per cent. The latter was determined on about half a gram. of another portion of equally well-picked mineral by boil-

* Read before the Chemical Section of the Franklin Institute, May 2, 1882.

* Read before the Chemical Section of the Franklin Institute, September 5, 1882.

ing the total unignited silica for some time in a concentrated solution of sodium carbonate. In the previous analysis I found total SiO_2 32.32 per cent., and gangue 9.22 per cent. I am inclined to believe that the second determination of the gangue is the more correct of the two, chiefly because larger quantities were used and the treatment with sodic carbonate could be made more thorough. This gangue, obtained as residue insoluble in sodic carbonate solution and afterwards ignited with the filter and weighed, was examined microscopically with the polariscope and an interposed selenite plate. It was found to contain a very considerable proportion of unmistakable free quartz, much of which polarised very distinctly.

The remaining parts of the full analysis of this sample of the mineral have not yet been completed.—*Journal of the Franklin Institute.*

EXAMINATION OF WATER AND AIR FOR SANITARY PURPOSES, WITH REMARKS ON DISINFECTION.*

By ROMYN HITCHCOCK.

It is not my purpose in this note to bring before you any new discovery or observation, but rather to call forth an expression of the opinion of chemists who have been engaged in examinations for sanitary purposes. The question I propound for discussion is this:—

Under what circumstances can a chemist condemn a water for household use?

It is well known that the presence of chlorides, nitrites, &c., in water is indicative of contamination with sewage, or with organic matter of some kind, and, by general consent, such waters are regarded as unsafe for household use. On the other hand, it must be admitted that the constant use of such waters for drinking is only occasionally followed by diseases which can be attributed to them. Certainly chlorides and nitrites are incapable of producing contagious diseases. Therefore, there must be another element in those waters which produce typhoid fever for example, that may or may not accompany the compounds mentioned. At present it is almost universally conceded that this element is a living microscopic germ, which develops and multiplies in the water. If this is true, it is obvious that the results of a chemical analysis are quite incompetent to prove the healthfulness of a water.

Granting this, it may be argued that chemical examinations are quite useless for sanitary purposes. The fact is quite otherwise. For although the chemist cannot detect the germs of disease, which likewise baffle the scrutiny of the microscopist, his analysis indicates the sources of contamination. It enables us, therefore, to trace the contamination to its source and thus determine its nature.

Perhaps it will be a somewhat startling assertion to say that the drainage from vaults containing human dejecta is not necessarily unhealthful. Yet the truth of it is demonstrated by the immunity from contagious diseases of thousands of families whose wells are situated close by and below such vaults. Sanitarians become greatly excited over the condition of affairs in this respect all over the country, and they predict most direful epidemics. But, somehow, the epidemics do not come. Chemists examine the water, Boards of Health order the wells closed, and families complain of the injustice of it because they have never suffered from the use of the water. Evidently, theory and experience do not correspond.

Nevertheless, the explanation is simple enough. Let there be a single case of typhoid fever in a house when the well is thus contaminated, and the probability is that those who drink the water will also take the disease. The germs will be carried into the well. They may be disseminated from it through the entire community, and the result would be, and often has been, a wide-spread epidemic.

This is a fact of observation and quite independent of any theory of the origin of disease. Therefore, chemical examinations of water are of value, not in that they prove that the water is unhealthful, but because they indicate the possibility of its becoming a vehicle of disease and point out the source of the contamination.

In regard to the examination of air there is much confusion as to the value of the results. I refer now to air as a vehicle of contagion, and not to its purity from a chemical point of view; and I trust no one will misunderstand my position in this regard, for there is no doubt as to the bad influence upon health of an excess of carbon dioxide, carbonous oxide, and other chemical impurities.

I maintain, however, that air which is chemically pure may be a vehicle of contagion; and that air, which is chemically very impure, may be perfectly harmless as regards contagion. In other words, sewer gas, whatever that strange combination of odours may be, is not, *per se*, a vehicle of contagion. If it were, the population of New York City would be decimated every year. One of the most striking examples of a want of information concerning this subject was given last year by some of the physicians of the highest standing in New York, where the popular excitement about the danger of dirty streets was at its height. The doctors had a great meeting and foretold that there would be a great pestilence if the streets were not cleaned, and they worked themselves up into a state of excitement that frightened the people very much, and, perhaps, at the time they believed all they said. But the city escaped, and the streets were not immaculate, and have not been so since.

I would not say that the health of the city was not affected by the condition of the streets. Very likely it was; but the effect was merely that of air contaminated by the gases arising from the decomposition of refuse matter, and utterly incapable of breeding a pestilence.

Ammonia and sulphuretted hydrogen, and the various other gases which arise in this way do not produce contagious diseases.

But if the atmosphere carries the germs of disease it is not unlikely that these will be most active where the air is impure. For, if these be germs of living organisms they will doubtless find a suitable nidus for growth and multiplication where decomposition is going on, and they will be disseminated by the rising gases. It is very likely that some of them increase in virulence where they grow shielded from the free access of air. But so long as the germs are absent sewer gas or effluvia of any kind will not generate contagia.

About three years ago Professor R. O. Doremus read an article before the Medico-Legal Society of New York, entitled "Epidemics from a Chemical Standpoint." In the experiment which he then performed the permeability of sandstone, brick, &c., to gases was demonstrated. This fact is well known to chemists, but the experiment proves nothing more than that the poison of contagia may be retained by the porous walls of houses. It should not be inferred, however, that the contagia are able to pass through the stone, for that has not been proved, and is, indeed, highly improbable.

Experiment indicates that all the floating germs of contagious disease may be filtered from the air by means of cotton. Gun-cotton can be employed for this purpose, after which it can be dissolved and the germs will settle to the bottom of the solution where the microscopist can find them. There are also other methods of collecting them for examination. The microscopic examination of air is, therefore, very important. But it should only be entrusted to careful investigators—persons who are not too hasty in drawing inferences from experimental results. The more one studies the microbes of the air the more fully he realises the immense field to be gone over before the results can be properly interpreted. To definitely declare the relation between these microbes and specific

* A Paper read before the American Association for the Advancement of Science, Montreal, August, 1882.

diseases now indicates a very superficial knowledge of the subject. For it is impossible to distinguish by sight between a bacterium that is virulent and one that is harmless.

The results of experience may therefore be summed up in a few words, thus: We have no means of determining when a water which analysis shows is liable to become a carrier of disease does become active in its dissemination, nor can we yet determine whether the air we breathe is or is not loaded with the germs of disease.

But we cannot doubt that after years of continuous observation by competent persons satisfactory results will be obtained. I regard it as a national misfortune that the National Board of Health has been unable to secure an appropriation adequate to continue its work and the publication of the *Bulletin*.

Sceptics may question the value of these investigations, but let us look for a moment at the actual results in saving human life, shown by the statistics of England and Wales for successive periods of ten years since 1841. The annual death-rate for those countries, for ten years, from 1841, was 22·4 in 1000 persons; for the next ten years it was 22·2, and for the next ten years, up to 1870, it was 22·5. For thirty years, therefore, it remained quite stationary. Then sanitary science was applied to diminish the death-rate, and in the next ten years, from 1871 to 1880, it fell to 21·5. This represents the saving of a quarter of a million lives. A further examination of the statistics also shows that this saving of life is in great part due to the effect of sanitary laws upon the prevalence of certain zymotic diseases. In exact figures, 0·78, or more than three-fourths of the improvement, is due to this alone. The fever death-rate has fallen from 0·80 per 1000, in 1870, to 0·32 in 1880.

Another subject, upon which there is considerable misapprehension, is the efficiency of disinfectants. Here again the sanitarian can act without relying upon any theory of disease; for whether there be a living germ or a chemical poison the disinfectant must be strong enough to kill the one, or at least to render it inactive, and to decompose the other. The utter inefficiency of carbolic acid vapour, or of any aerial disinfectant whatever, in a sick-room, will be evident to anyone who is familiar with the microscopic study of living germs. For it is known that they can withstand treatment with chemicals which would instantly destroy the life of higher organisms, and no atmosphere which we could breathe would destroy or materially affect the vitality or activity of disease-germs. It may be said that ordinary aerial disinfection is utterly useless. The only efficient method in the sick-room is the immediate disinfection of all refuse and thorough ventilation.

A more accurate knowledge, on the part of some persons, of the capability of germs to resist destruction would prevent the advocacy of absurd and impracticable schemes for disinfection, such as the freezing out of yellow fever from a ship, and others of like character. It may be assumed with a fair degree of probability, that yellow fever, or any other contagious disease, will not be carried around in a ship's hold if the latter is thoroughly aired and ventilated, and by a proper regard to sanitary conditions the quarantining and disinfection of vessels, after long voyages from infected ports, would be rendered quite unnecessary.—*Journal of the Franklin Institute*.

A New Variety of Glass.—The *Wiener Gewerbe-Zeitung* states that a chemist of Vienna has invented a new kind of glass, which contains no silex, potash, soda, lime, nor borax. In appearance it is equal to the common crystal, but more brilliant; it is perfectly transparent, white, and clear, and can be cut and polished. It is completely insoluble in water and is not attacked by fluoric acid, but it can be corroded by hydrochloric and nitric acid. When in a state of fusion it adheres to iron, bronze, and zinc.—*Gaceta Industrial*.

CORRESPONDENCE.

THE PROPOSED MEETING OF THE BRITISH ASSOCIATION IN CANADA.

To the Editor of the Chemical News.

SIR,—I received a circular from members of the British Association who are opposed to meeting in Canada. Some of their arguments are good, but none are to me overpowering. It is said that the founders never contemplated going out of Britain. The founders of the kingdom of England never contemplated growing into Britain, or Great Britain, and Greater Britain. This latter fine expression seems to have escaped the sympathy of many scientific men. For one I should feel glad to see Canada included in our scientific limits, and I think that the Association might do much towards promoting fellow-thought in Science, as well as fellow-feeling, or feeling of kinship.

It is said that the present practice has been justified by fifty years, and the change will be disappointing. Fifty years, and no change! Is not this disappointing? The British Association is perhaps the least disposed of all the great societies to yield to a clique; but is it not possible that, even to this scientific body, the breezes of the Atlantic might impart vigour, blow out the dust from many a corner, and help the cure of troublesome sores, if any exist?

Is not the desire itself to go to Canada a proof of the fine influence of the Association? Its spirit is spreading abroad. Are we so old or so narrow that we can only stay at home?

Many societies are imitating the Association in their annual meetings, and the great interest in the larger one has visibly diminished, and must diminish more unless there is some change. Financial difficulties may occur, but I should be sorry to see the Association straining itself to make attractions on this account. I should prefer to see it pressed for time to deliver its message to the public, and this might happen if its meetings were rarer here, as we cannot expect that all who would read papers at home would go to Canada. This would leave more for the next meeting here. Canada would not see the meeting in all its vigour, but both sides would make friends, and both would work more freshly in their homes after their discussions.

A decision could not be arrived at unless a number of the members here would go to represent in a fit manner the Association. I hope this number will be found, and I am only sorry that I cannot be one.—I am, &c.,

R. ANGUS SMITH.

Manchester, December 29, 1882.

NITROGEN IN COAL.

To the Editor of the Chemical News.

SIR,—At a meeting of the Chemical Society on the 21st ult. a paper was read by Professor Foster on the "Behaviour of Nitrogen in Coal during Destructive Distillation." This subject was taken up by Mr. William Young and the writer several years ago, with the result that a process was devised and patented by which a very large proportion of the nitrogen which had formerly been left in the coke or carbonaceous residue from the destructive distillation of coals, shales, ironstones, &c., can be recovered commercially. This process has been in successful use on a large scale since May, 1881. I have no wish to use this as an opportunity for the advertisement of a patented invention, and therefore refrain from saying anything as to the process and its results. The Patents referred to are 1587, 2169, 4284, all of 1881, and 1377 and 5084 of 1882.

A few months ago I consulted Professor Crum Brown

as to the propriety of bringing a paper on the subject before the Chemical Society, but we agreed in thinking that from a purely scientific point of view the facts brought to light were either not sufficiently novel, or where novel, were not sufficiently clearly worked out on the scientific side, to justify me in bringing them before a scientific society. My partner, Mr. Wm. Young, read a technical paper on the subject before the North British Association of Gas Managers several months ago. I fully appreciate the scientific value of Professor Foster's papers, and regret not having been present at the meeting to hear it.—I am, &c.,

GEORGE BEILBY.

Midcalder, January 2, 1832.

ESTIMATION OF PHOSPHORIC ACID AS MAGNESIC PYROPHOSPHATE.

To the Editor of the Chemical News.

SIR,—For some months past I have been closely engaged in testing the accuracy, under various conditions, of the above method for estimating phosphoric acid, and I fear it will be some months before the enquiry can be brought to a close.

In the CHEMICAL NEWS (vol. xlv., page 213) I observe an article from the *Journal of the American Chemical Society* on the same subject by Mr. Gladding, who has worked with microcosmic salt, the substance which I also have employed.

In his experiments no allowance appears to have been made for the solvent action of the dilute ammonia used to wash with. Though the loss sustained from this cause appears to me at present to be less than has generally been supposed, it is undoubtedly a measurable quantity, introducing an error, which, though it may be compensated and in many instances more than balanced, by error in the other direction arising from retained impurities, must not be lost sight of, as it will sensibly affect the results if we succeed in obtaining a pure precipitate.

My paper when complete will be offered as a contribution to your valuable journal.—I am, &c.,

DAVID LINDO.

Falmouth, Jamaica,
December 7, 1882.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcv., No. 25, December 18, 1882.

On Maize at Different Epochs of its Vegetation.—M. H. Lepage.—The author demonstrates the conversion of sugar into cellulose, and has succeeded in the artificial reproduction of this phenomenon.

On Solar Photometry.—M. A. Crova.—The author proposes to obtain the measure of the relative intensities of two lights of different tints by the photometric comparison of one and the same simple radiation chosen in each. In the sun and in the standard Carcel lamp he selects a yellowish green radiation of the wave-length 582. Practically it is obtained by means of a mixture of solutions of ferric and of nickel chlorides, through which the light is allowed to pass. Daylight and lamplight seen through this medium appear exactly of the same colour. By making use of this method he finds the light of the sun in a clear sky equal to 60,000 Carcels.

Researches on the Duration of the Solidification of Bodies in a State of Superfusion.—M. D. Gernez.—The author has made some determinations on phosphorus in a state of superfusion in very narrow glass tubes. He finds that in the same tube the duration of the solidification is the same for equal lengths of the liquid column. The temperature to which the phosphorus had been previously heated had no influence. The rate of solidification remains constant however many anterior operations have been effected with the same body, and what may have been the duration of each.

Crystallisation of Chlorine Hydrate.—M. A. Ditte.—The author describes a process for obtaining this compound in well-defined crystals, of 2 to 3 m.m. in length. Their colour is of a deep greenish yellow, and their form is derived from the regular system.

On Pyro-sulphuryl Chloride.—M. D. Konovaloff.—M. Ogier has recently drawn attention to this compound as forming an exception to the law of Avogadro. M. Konovaloff shows that this is not the case, its vapour-density being normal. The following determinations have been obtained experimentally:—7'37, 7'20, 7'24, 7'41, 7'23, 7'39. Theory requires 7'43.

The Products of the Distillation of Resin.—M. Ad. Renard.—The portions of the volatile oil which passes over below 100°, if washed with soda and agitated with a strong solution of sodium bisulphite give a crystalline deposit, formed by a combination of sodium bisulphite with various aldehyds. The portion which resists solidification is washed afresh with soda and by fractionated distillation is split up into two hydrocarbons, boiling, the one at 67°—70°, and the other at 30°—40°.

Justus Liebig's Annalen der Chemie,
Band 215, Heft 3.

On Caffeine, Theobromine, Xanthine, and Guanine.—Emil Fischer.—The author undertakes in this memoir a revision of Rochleder's experiments on the decomposition of caffeine by chlorine. Like Rochleder he obtains amalic acid, chlorocyan, and methylamin, but considers them as products of a secondary reaction. He then describes the derivatives of caffeine, *i.e.*, chloro-caffeine, bromo-caffeine, amido-caffeine, ethy-oxy-caffeine, hydroxy-caffeine, di-ethy-oxy-hydroxy-caffeine, di-meth-oxy-hydroxy-caffeine, allo-caffeine, apo-caffeine, caffuric acid, hydro-caffuric acid, hypo-caffeine, caffeline, with its reduction and oxidation products, the latter of which vary according as the agent employed is potassium ferricyanide, permanganate, or chromic acid; further, acetyl-ace-caffine, and ace-caffine. Under theobromine he describes bromo-theobromine, brom-ethyl-theobromine, hydroxyl-ethyl-theobromine, and hypo-ethyl-theobromine. He remarks that one and the same methylamine is split off in the formation of the apo- and hypo-compound both of caffeine and theobromine. He then describes the preparation of xanthine and its conversion into theobromine and secondarily into caffeine. Thus it is proved that theobromine and caffeine are respectively to be considered as dimethyl- and trimethyl-xanthine, and suggests that, as the vegetable bases theobromine and caffeine are so closely related to the animal excretions xanthine and guanine, all these compounds are possibly formed in the organism by the same process.

Communications from the Chemical Institute of the University of Strasburg.—These consist of a paper by R. Henriques on new nitro-compounds of phenol; a memoir by Paul Hepp on the trinitro-derivatives of benzol and toluol; and a paper by the same author on the addition-products of nitro-derivatives with hydrocarbons.

Cosmos Les Mondes.
No. 15, December 9, 1882.

This number contains no chemical matter.

No. 16, December 16, 1882.

A man who was very close to a tree struck by lightning asserts that he was saved by crouching on the ground and covering himself with a *woollen* umbrella. He was "enfolded in flames and completely electrified," but received no hurt!

No. 17, December 23, 1882.

M. Maumené addresses to the editors a letter which he had previously forwarded to the *Annales de Chimie et de Physique*. In this letter he points out that he has been the first, as admitted by MM. Dumas, Pasteur, Chevreul, and Würtz, to advise chemists not to study chemical actions without determining all the terms. He adds that his theory has enabled him to foresee the existence of eight acids, two of which he has produced and analysed, whilst the remainder will be obtained shortly.

Falsification of Oils.—M. Barthe.—The author gives a table of the specific gravities of the chief vegetable oils, and of their mixtures.

Mixed Domestic Lighting.—An illustrated paper.

Journal de Pharmacie et de Chimie.
Tome vi., November, 1882.

Researches on Jalaps.—M. A. Bouriez.—A purely pharmaceutical paper.

Assays of Potassium Sulpho-Carbonates.—M. Guyot-Dannecy.—The author, to determine the proportion of carbon disulphide present, introduces into a 2-litre flask 1 litre of distilled water, in which 100 grms. zinc chloride are dissolved. In this flask is adapted a good cork with two holes. Through one of these is plunged a long tube-funnel, the lower end of which reaches to 1 centimetre from the bottom. To the second hole is fixed a tube bent at right angles, for conducting the vapours into a condenser cooled by a current of cold water, and thence into a receiver plunged in ice. The apparatus being thus arranged and the joints made air-tight, the flask is placed in the water-bath and heated. When the solution of zinc chloride has reached about 60° the potassium sulpho-carbonate is introduced little by little through the tube-funnel. There is produced a brisk effervescence due to the escape of carbon disulphide. No more sulpho-carbonate must be added until this has entirely ceased. The process is thus continued till the whole of the weighed sample has been introduced, when the distillation is continued until all the carbon disulphide is collected in the receiver. Its weight indicates its proportion in the sulpho-carbonate.

Analysis of Ground Alunite as Supplied to Alum Works.—The alunite in question is that of La Talfa, near Rome. It contains potassium sulphate 13.20 per cent; aluminium sulphate combined with potassium sulphate 25.52; free sulphate of alumina, 4.60; and free alumina, 17.

On a Variety of Albumen in Urine Coagulable by Nitric Acid and Re-soluble in Alcohol.—M. L. Garnier.—In two cases of nephritis the urine on treatment by Heller's process gave a precipitate which instantly re-dissolved in alcohol.

New Method of Preparing Vesicatories.—M. Limousin.—A memoir of purely pharmaceutical interest.

Extract of a Medico-Legal Report on a Case of Poisoning by Strychnine.—MM. Schlagdenhauffen and Garnier.—The authors describe very circumstantially their examination of the stomach, brain, and liver of Ernestine Martiné. They ascertained the absence of brucine and morphine, and proved the presence of strychnine by its physical and chemical characters, and by its physiological effects upon a frog and a rabbit. Arsenic was also found in the stomach, liver, and brain.

The Electrical Exhibition.—M. Le Roux.—The continuation of a lengthy illustrated memoir.

Preservation of Woods.—M. Fayol.—The author finds that treatment with tar increases and sometimes doubles the duration of oak timber used in collieries, but has little influence upon that of pine. Oak wood prepared with ferrous sulphate lasts ten times longer than in its unprepared state, on immersion for 24 hours in a solution of 200 grms. ferrous sulphate per litre.

Rapid Preparation of Oxygen.—M. Voracek.—The author pours hydrogen peroxide upon a small quantity of potassium permanganate. There is an abundant disengagement of oxygen at common temperatures.

New Reagent for Nitrous Acid.—M. Jorissen.—From the *Zeitschrift f. Anal. Chemie*.

Preparation of Succinic Acid from Tartaric Acid.—M. F. König.—Dissolve 2 kilos. tartaric acid in water, neutralise with ammonia, dilute to 30 litres, add to the solution 20 grms. potassium phosphate, 10 grms. magnesium sulphate, a few grms. calcium chloride, and about 20 c.c. of a solution of ammonium tartrate in fermentation which is easily obtained by letting some of the same liquid stand for some days, diluted with five times its weight of water. By degrees the mixture becomes turbid, and swarms with bacteria. It is then left to itself for six to eight weeks at a temperature of 25 to 30°, covered as well as possible from the air, until the slight escape of gas ceases, and there is no more tartaric acid. It is then evaporated to expel ammonium carbonate, clarified with white of egg and milk of lime so as to leave the boiling liquid alkaline. When cold the deposit of calcium succinate is pressed and decomposed by sulphuric acid. The liberated succinic acid is purified by known means. Two kilos. tartaric acid yield 500 grms. succinic acid, the theoretical yield being 524 grms.

Composition of Human Fat at Different Ages.—M. L. Langer.—The fat of a child contains less oleic acid, but more palmitic and stearic acid than that of adults. It is also richer in the butyric and caproic acids.

Molybdenum Binoxide.—F. Mauro and R. Panebianco.—This compound may be obtained in definite crystals by heating in a platinum crucible at the high temperature of a Perrot furnace for three or four hours a mixture of 14.4 grms. anhydrous molybdic acid, 14 grms. dry potassium carbonate, and 7 grms. of melted boric acid. It is let cool in the furnace. On treating the fused mass with water the enclosed crystals are liberated, and are washed first with ammonia and then with water. The crystals are prisms with a four-sided base terminating in a pyramid. They have a metallic lustre, a colour between that of copper and of lead, and their sp. grav. at 16° = 6.44. Crystalline molybdenum binoxide may be transformed into molybdic acid; the conditions of this conversion lead the authors to take 96 as the atomic weight of molybdenum, thus agreeing with the determinations of M. Dumas and M. Debray.

December, 1882.

On the Origin of Arsenic and Lithia in Selenitic Waters.—M. Schlagdenhauffen.—The author finds arsenic in all varieties of gypsum which he has examined. He considers that the subterranean waters take up calcium arseniate from the gypsum beds. The origin of the arsenic contained in the gypsum is doubtless the arsenic sulphide contained in marls along the pyrites. This arsenic sulphide in contact with waters charged with calcium carbonate and bicarbonate is gradually converted into calcium sulph-arseniate and finally arseniate, in which state it dissolves in the water. The marls contain also lithia, though in a form yet unknown.

Rapid Process for Determining Salicylic Acid in Beverages.—M. A. Rémont.—A colorimetric process already noticed.

Want of Permanence in Syrup of Tolu.—M. Malenfant.—A purely pharmaceutical paper.

Analysis of the Coal of Muaraze.—M. A. Guyot.—This coal, from the valley of the Zambesi, is found in thin beds intersected by carbonaceous schists. It contains from 22 to 29 per cent of ash.

Presence of Arsenic in the Waters of Baréges.—M. Schlagdenhauffen.—The waters in question contain arsenic in the form of alkaline arseniate and sulph-arseniate.

Cultivation of Opium in the Zambesi.—M. P. Guyot.—Not suitable for our columns.

Artificial Colouration of a Cinchona by Ammonia.—MM. Ch. Thomas and G. Guignard.—It is common to transform common yellow barks into red barks by steeping them for a few moments in ammoniacal water. To detect this fraud the authors treat a standard bark and the suspected sample with boiling water under identical conditions. The liquids obtained are filtered, and when cold are tested with Nessler's reagent, freshly prepared. The standard sample gives a white precipitate, but the artificially coloured sample gives a very decided red-brown colouration.

Modifications Produced in Milk by Certain Medicines.—Dr. Stumpf.—Potassium iodide diminishes notably the secretion. The albumenoid matter suspended in the milk and the sugar increase, whilst the fatty matters diminish. The quantity of the potassium iodide eliminated in the milk is very slight. The use of alcohol increases the fatty matter but leaves the albumenoid principles and the lactose, as well as the total quantity of the milk, unaltered. Salicylic acid stimulates the secretion, but pilocarpine has no such action. Salicylic acid increases the proportion of lactose. In women this substance passes into the milk in larger proportion than in the female herbivora. The use of plumbic preparations causes lead to appear in the milk.

Toxicological Detection of Solanine.—M. Dragendorff.—Not capable of useful abstraction.

Reaction of Narceine.—M. Arnold.—If we heat a trace of narceine with a mixture of equal parts of sulphuric acid and of phenol we obtain at first a yellow colouration, then a brown, and when the phenol begins to volatilise a fine cherry-red colour, if the action of the heat is continued. Some drops of water suffice to transform this colour into a dirty yellowish white. Veratrine, if similarly treated, gives the same red colouration, but on the addition of water it gives a canary yellow. Codeine becomes a dirty violet-red, and of a dirty brown if the temperature is raised. Delphinine is at first a brick-red, which turns to a reddish-brown on heating.

Creosote of Beech-Wood Tar.—M. Gratzel.—Creosote with an aqueous solution of ferric chloride takes a blue colour which quickly passes to a brown. Phenol, if similarly treated, takes a violet-blue colour, which is permanent.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xi., Part 10.

Quantity and Composition of the Rain and Drainage Waters at Rothamsted.—Messrs. Lawes, Gilbert, and Warrington.—From the *Journal of the Royal Agricultural Society*.

Formation of Nitric Acid in the Soil.—From the *Journal of the Society of Arts*.

Formation of Nitric Acid in the Soil.—Marié-Davy.—Soil from the plain of Gennevilliers was placed in a glass vessel and received daily 1 litre sewage which contained initially 20.6 m.g. ammoniacal nitrogen and 0.8 m.g. nitric nitrogen per litre. In the effluent there was, per litre, 1.7 m.g. ammoniacal nitrogen and 21.5 nitric nitrogen.

Influence of the Texture of Commercial Manures upon their Efficiency.—Prof. P. Wagner.—In every case finely-ground manures gave the best results.

Interchange of Gases and the Chemical Modifications in a Hen's Egg during Incubation.—R. Pott and W. Preyer.—Not suitable for abstraction.

Food Experiments with "Huck's Strength Food" on Horses.—Vet. Surgeon Pindeisen.—The horses experimented upon gained very decidedly in weight.

Micro-spectroscopic Observation of the Excretion of Oxygen from Vegetable Cells.—Th. W. Engelmann.—The separation of oxygen from the green cells depends on the wave-lengths of the light. The greatest liberation of oxygen was occasioned by the rays between Fraunhofer's lines B and C.

Excretion of Carbonic Acid from Plants in the Absence of Oxygen.—W. P. Wilson.—The author refutes Worimann's view that the carbonic acid exhaled by plants is entirely a product of intra-molecular processes.

Action of Various Gases and Especially of Nitrous Oxide.—Seeds of the pea and of wheat cannot germinate in an atmosphere of pure nitrous oxide, and a prolonged stay in this gas proves fatal. Living plant-cells are incapable of decomposing pure nitrous oxide and of utilising its oxygen.

Action of Gases and Liquids upon the Vitality of Vegetable Forms.—Italo Giglioli.—Air-dried seeds resisted the action of nitric oxide, hydrogen sulphide, and sulphurous acid, and even of dry ammonia, for some time. Moist seeds perished quickly in the above gases, and even in oxygen and nitrous oxide. Seeds of lucerne in some cases resisted the action of boiling ether (160 hours), boiling carbon disulphide (81 hours), and boiling absolute alcohol (5 hours).

Cholesterines.—E. Schulze and J. Barbieri.—From the *Journal für Praktische Chemie*.

Contributions to a Knowledge of Lignine and of Lignified Tissues.—Max Singer.—Not suitable for abstraction.

Determination of the Mineral Constituents of a Sugar-Cane Affected by Fungoid Disease.—Prof. W. Knop.—The most remarkable point is the great quantity of magnesia in proportion to the lime. The large quantity of chlorine and the low percentage of the total ash are also noteworthy.

Enemies to the Vine.—F. V. Thürmen, Madame Ponsot, &c.—A description of fungi, insects, &c., injurious to vineyards.

Journal für Praktische Chemie.

New Series. Vol. xxvi, Nos. 6 and 7. 1882, 17 and 18.

Platinum-Bases Formed by the Electrolysis of Ammonium Carbamate and Carbonate with Alternating Currents and Platinum Electrodes.—Bruno Gerdes.—The author obtains two new bases, ammon-platin-diammonium and diplatin mono-diammonium.

Ammon-platin-diammonium Compounds.—E. Drechsel.—Remarks on the foregoing manual.

On Carbon Disulphide, and Especially on its Behaviour with Potassium Permanganate.—Eugen Obach.—The author's principal results are that neither solid potassium permanganate nor its aqueous solution, neutral or acidified, has any direct action upon pure carbon disulphide, nor upon the evil-smelling impurities present in commercial samples. Hydrogen sulphide, if present, is destroyed, and free sulphur often passes into solution. The slow reduction of the permanganate solution effected by pure carbon disulphide is a secondary reaction depending upon hydrogen sulphide, which is formed by the action of light. In impure carbon disulphide the amount of the fixed matter which remains after evaporation is increased by prolonged treatment with permanganate. Among the substances tried as purifying agents powdered mercury sulphate gave the best results as far as the removal of the thio-carbimides is concerned. For complete

purification, after the previous removal of water and dirt, the following method is recommended:—Distillation over quicklime, agitation with powdered permanganate, then with metallic mercury, and afterwards with mercury sulphate. Lastly, rectification over calcium chloride directly into the stone bottle, which must be preserved from light. Silver, mercury, and copper act upon carbon disulphide, which is otherwise pure but contains hydrogen sulphide, rather quickly in presence of air, with formation of the corresponding sulphides. If air is excluded silver is not at all discoloured, mercury scarce perceptibly, but copper distinctly. When testing for traces of free sulphur in presence of hydrogen sulphide the operation must be conducted in a filled test-flask, so as to exclude air. Alkaline solutions of lead decompose sooner or later the vapour of carbon disulphides and certain of the thio-carbimides, so that they cannot be used for the detection of hydrogen sulphide.

Foundation of my Estimates of Ad. Baeyer's Scientific Qualification.—H. Kolbe.—A personal criticism not suitable for reproduction in the CHEMICAL NEWS. The author concludes with the remark that chemical science in Germany declines more and more.

Elementary Composition of Rice-Starch, and on its Quantitative Determination.—F. Salomon.—Not adapted for useful abridgment.

Uro-roseine, a New Urine Pigment.—M. Nencki and N. Sieber.—This pigment was first found on adding pure hydrochloric acid to the urine of a diabetic patient. In four other cases of the same disease it was absent. Hitherto it has not been detected in the urine of healthy persons, but in that of about 10 per cent of patients affected with chlorosis, osteomalacia, nephritis, typhus abdominalis, &c. It is of a beautiful rose-colour, dyes wool and silk, and may be separated from urine by gentle agitation with amylic alcohol. It is very unstable, and has not yet been sufficiently purified for analysis.

Revue des Industries et des Sciences Chimiques et Agricoles.
Tome vi., No. 58.

Meeting of the Central Society of Chemical and Agricultural Sciences and Industries, April 27.—M. Joulie, with reference to a lecture which he had lately delivered on wheat, remarked that in analyses of soils, he attended only to the potassa soluble on digestion of the soil in *aqua regia*. The potassa present in the form of silicates not attacked by this solvent must be ignored, as it was not available as plant food. The solvent power of *aqua regia* for potassium compounds far exceeds the absorptive power of plants, so that only a small fraction of the potassa thus dissolved can be considered available. Except in calcareous districts, the greater part of arable soils contain no phosphate but that of iron. The phosphates introduced as manure, whether alkaline or aluminous, are rapidly converted into iron phosphate on being dissolved in the carbonic acid, which impregnates the soil. A soil in order to yield 40 kilos. of phosphoric acid to a crop of wheat, must contain at least 4000 kilos. of that acid in the arable stratum. Organic matter is useful by reducing ferric phosphate to the ferrous state. The latter salt yields its acid more easily to plants.

Note on the Phosphates of Brazil.—M. Pellet.—These phosphates much resemble those of Burgundy, and contain much alumina and iron.

Studies on Means of Reducing the Production-Cost of Wheat.—H. Joulie.—Not capable of useful abridgment.

Treatment of Waste-waters.—MM. Gaillet and Huet.—There is here little novelty. Ferric chloride is recommended as a precipitating agent, and, in general, sulphates are pronounced inferior to chlorides. The precipitated

matter is recommended as a source of lighting-gas. A strange process is described, in which the sewage, &c., is treated first with lime, then with oxalic acid (*sic*!), and lastly with oxalic acid again.

Tome vi., No. 59.

Note on the Volumetric Determination of Carbonic Acid.—Armand le Docte.—The author proposes a new apparatus, the construction and use of which cannot be intelligibly described without the accompanying diagram and tables.

Means of Reducing the Production-Cost of Wheat (Continuation).—The author shows that farmyard manure does not offer its elements in forms sufficiently available, and that its use in large doses involves a heavy outlay; the only result is to enrich the soil uselessly with elements of little activity. The author sums up his advice for the production of wheat cheaply as follows:—Keep the soil always well stored with the indispensable mineral elements, which will not cost more than 1.09 franc per hectolitre of wheat. Take possession of the nitrogen of the atmosphere by the cultivation of forage plants, which then transfer it to the wheat. M. Joulie, like M. Ville, considers that lucerne, &c., assimilate the free nitrogen of the atmosphere.

Tome vi., No. 60.

Culture of the Sugar-Cane at Guadeloupe.—The author recommends to apply 80 to 100 grms. of chemical manure per plant, covering it with a layer of soil. The number of canes per hectare is 10,000.

Nutritive Value of the Different Pulps from Sugar Works and Distilleries.—H. Pellet.—Not capable of useful abstraction.

Studies on the Vanadium Industry.—F. Osmond and G. Witz.—Already noticed.

Tome vi., No. 61.

Studies on the Vanadium Industry.—F. Osmond and G. Witz.—Continued from the last number.—The authors give the following methods for the rapid determination of vanadium.

A. *Lindemann's Method.*—If, to a sulphuric solution of vanadic acid, we add a standard solution of ferrous sulphate, the iron passes to the maximum state of oxidation, and the vanadic acid is reduced to the hypo-vanadic. The liquid, which is at first of a light yellow, turns to a green and then to a blue. The reaction is complete when a drop, placed upon a white porcelain plate, turns a drop of freshly made and very dilute solution of potassium ferricyanide to a blue. It is necessary to operate in presence of a notable excess of sulphuric acid, otherwise the reaction remains incomplete. This method is applicable in presence of all the components of basic slags. We prepare beforehand:—(1.) Dilute sulphuric acid formed of 1 vol. mono-hydrated acid and 4 vols. water. (2.) A solution of ferrous sulphate obtained by dissolving, with exclusion of air, 2.183 grms. pianoforte wire in the acid above mentioned, and diluting it to 1 litre with the same. 1 c.c. corresponds to 2 m.g. vanadium. It is well to prepare this solution afresh for each series of determinations. (3.) A weak solution of potassium permanganate equivalent to the former, and containing 1.234 gm. pure permanganate per litre. (4.) A stronger solution of permanganate, e.g., such as is used in the determination of iron in minerals. We treat 2 grms. of powdered slag with 30 c.c. of the sulphuric acid (1.); the action is almost instantaneous. We boil for a few moments and let cool. The presence of silica and calcium sulphate do not prevent the determination, but they interfere a little with the distinctness of the reactions. It is therefore preferable to attack 6 grms. slag with 90 c.c. of acid and filter off the third of the volume, or 30 c.c., which represent 2 grms. The vanadium and the iron are found dissolved in an undetermined state of oxidation. Both are brought to the maximum state by the stronger solution

of permanganate, added drop by drop until a permanent rose colour is produced. If an excess of permanganate has been employed it is destroyed by means of ferrous sulphate. The ferrous solution is then run in with the burette. When the colour begins to take a blue, like the copper salts, we learn that the point of saturation is near. The sulphate is then added more slowly, and spotting trials are made until a drop of the liquid gives a distinct blue colour with the dilute ferricyanide.

B. *Colorimetric Method*.—Hypo vanadic solutions may be very rapidly determined by comparing them either with a standard of known strength or with a salt of copper. The limit of exactness which the authors have reached in this manner appears to be 1-50.

C. *Spectro-photometric Observations*.—The choice of cupric solutions as permanent standards for the determination of vanadium is justified not merely by an apparent identity, but by the inner nature of the two colorations. We have compared with the fine spectro-photometer of Crova a solution containing per c.c. 2 m.g. of vanadium in the state of Va_2O_4 and a solution of cupric nitrate of an equivalent coloration. Both present the same general characters; absorption of the red part of the spectrum decreasing to beyond the ray D. Hypo-vanadic solutions rendered green by an excess of hydrochloric acid give an absorption spectrum differing little from that of the blue solutions.

On the Incrustations of the Triple Effects.—H. Pellet.—For the prevention of these incrustations the author recommends the filtration of the cane-juice, the use of lime free from sulphate, and the precipitation of dissolved sulphate by means of ammonium carbonate.

Use of Manures in Vineyards.—Dr. A. Stutzer.—Each vine should receive yearly 6 to 7 grms. soluble phosphoric acid, 5 to 6 grms. potassa, and $2\frac{1}{2}$ to 3 grms. nitrogen.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 2, 1882.

Process for Determining Ammonia by Distillation.—Dr. O. Knoblauch.—This memoir cannot be usefully reproduced without the accompanying illustration.

Preparation of Normal Acid.—Dr. O. Knoblauch.—This paper cannot be understood without reference to the foregoing.

Expansion of the most Important Volumetric Solutions by Heat.—A. Schulze.—The author refers to a memoir by P. Casamajor, in which the latter maintains that the expansion of volumetric solutions by heat cannot be neglected in case of exact determinations, but that the tables of expansion calculated for pure water may be safely applied in view of the great dilution of the standard liquids. He examines whether, in spite of this great dilution, notable differences do not appear between the changes of volume of distilled water and those of the liquids used in titration, and has for this purpose made a series of experiments upon sixteen of the more important of these liquids, at temperatures ranging from 0° to 30°. He finds that, though the errors occasioned are not important, the rate of expansion of water differs in many cases very distinctly from those of standard solutions.

Remarks on the Determination of the Specific Gravity of Solids and Liquids.—Dr. G. Brügelmann.—The author proposes a method based on the use of a good balance and of a cylindrical graduated measuring instrument. For this purpose he recommends a Mohr's burette holding 50 c.c., and graduated in tenths of a c.c., or a Mohr's measuring pipette. For determining the sp. gr. of a liquid it is merely necessary to allow a suitable and adequately large volume to flow out of the burette and then to weigh. Solids are first weighed and then introduced into the burette, which contains a suitable liquid, and which is previously well dried internally above

the level of the liquid by wiping with filter-paper. The difference in the level of the liquid before and after the introduction of the solid shows the volume of the weight employed. The author recommends, as the liquid to be employed, benzol, toluol, or xylo. Porous bodies must of course be finely pulverised.

On Certain Wines of the Vintage 1879.—F. Musculus and Dr. C. Amthor.—The authors prove that, contrary to the assertion of wine merchants, the inferior wines of bad seasons contain an abnormally high quantity of extract, acid, ash, and phosphoric acid. The extract is of a gelatinous consistence, arising from pectinoid matter not converted into sugar.

Potassium Permanganate and Chromic Acid as Absorbents for Nitric Oxide.—Dr. C. Böhmer.—The author raises the question whether the method of Sachsse and Kormann for the determination of amidic acids is not capable of simplification. The method is founded on the transformation of nitrous acid with monamides. In an aqueous solution and with fatty bodies in general the nitrogen gas liberated from the amide furnishes a measure for the quantity of the amidic substance. For absorbing the nitric oxide evolved from the nitrous acid, ferrous sulphate has been employed. Instead of this the author uses a solution of potassium permanganate obtained by stirring up a slight excess of the salt in water. This reagent in an alkaline solution serves for the simultaneous removal of nitric oxide and carbonic acid. If the latter is not to be removed, chromic acid does better service. The author recommends a freshly-prepared solution of 50 grms. in 100 c.c. dilute nitric acid.

Two New Methods for the Detection of Cadmium in Presence of Copper in a Systematic Qualitative Analysis.—A. Orlowski.—These two methods depend on the power of sulphur completely to precipitate copper from its oxide salts in presence of a sufficient quantity of stannous chloride, and on the behaviour of sodium hyposulphite with solutions of copper.

First Method.—The blue liquid obtained after removal of the bismuth hydroxide is acidified with hydrochloric acid, and stannous chloride is added until the colour is destroyed. Milk of sulphur is then added, and the whole is heated to boiling. All the copper is thrown down as a black precipitate of copper sulphide. Filter, and add ammonia, when the tin is deposited as stannic and stannous hydroxide, whilst cadmium hydroxide, which is at first thrown down, is re-dissolved by the excess of ammonia. Filter again, and test the filtrate with hydrogen sulphide. A yellow precipitate indicates cadmium.

Second Method.—The blue solution, after removal of bismuth hydroxide, is acidified with hydrochloric acid, mixed with sodium hyposulphite, boiled till the precipitate passes from a yellow to a dark brown (not black) and the liquid is colourless and transparent. If cadmium is present the characteristic yellow precipitate will appear on neutralising the filtrate with ammonia and adding ammonium sulphide. The author recommends the second method as the simpler and better adapted for general use.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 8.—London Institution, 5.

Medical, 8.30.

Society of Chemical Industry.

TUESDAY, 9th.—Royal Institution, 3. "Light and the Eye," by Professor Tyndall.

Royal Medical and Chirurgical, 8.30.

Photographic, 8.

Institution of Civil Engineers, 8.

WEDNESDAY, 10th.—Geological, 8.

Microscopical, 8.

THURSDAY, 11th.—London Institution, 7.

Royal, 4.30.

Royal Society Club, 6.30.

FRIDAY, 12th.—Quekett Club, 8.

Astronomical, 8.

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Who were the first to introduce this substance to the notice of the Alum Trade, having shipped their first cargoes of about 200 tons in April, 1875, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

					DRIED AT 212° F.		
					Extra Quality.	First Quality.	Second Quality.
Alumina	...	...	...	...	65.00 p. ct.	52.37 p. ct.	43.41 p. ct.
Peroxide of Iron	...	...	...	...	0.50 „	1.29 „	1.81 „
Silica, &c.	...	...	...	...	4.50 „	19.24 „	34.35 „
Water of combination	...	...	...	...	30.00 „	27.13 „	20.52 „
					100.00	100.03	100.09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy; f.o.b. at Larne or Belfast; or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD,
Secy. and Com. Man.

29, ST. VINCENT PLACE, GLASGOW.

THE CHEMICAL NEWS.

VOL. XLVII. No. 1207.

CHEMICAL NOMENCLATURE AND NOTATION.

THE following instructions relating to these matters were addressed by the Council of the Chemical Society to the Abstractors in 1879,* and are now reprinted, with a few slight alterations, in the hope that they may have some influence in promoting uniformity of nomenclature and notation.

NOMENCLATURE.

"1. Employ names such as *sodium chloride*, *potassium sulphate*, *ethyl acetate*, and use the terminals *ous* and *ic* only in distinguishing compounds of different orders derived from the same elementary radicles, *e.g.*, mercurous and mercuric chloride, sulphurous and sulphuric acid.

"2. Term compounds of metallic and alcoholic radicles with (OH), *hydroxides* and not hydrates, *e.g.*, potassium hydroxide, phenyl hydroxide, the name hydrate being reserved for compounds supposed to contain water of combination or crystallisation. Compounds such as CH_3ONa , $\text{C}_2\text{H}_5\text{ONa}$, $\text{C}_7\text{H}_{15}\text{ONa}$, &c., should be termed sodium methoxide, ethoxide, heptyoxide, &c.

"3. Apply the term *acid* only to compounds of hydrogen with negative radicles, such as HNO_3 , H_2SO_4 , H_3PO_4 , and denote the oxides which form acids by names such as sulphuric anhydride or sulphur trioxide. Term salts containing an amount of metal equivalent to the displaceable hydrogen of the acid, *normal* and not neutral salts, and assign names such as hydrogen-sodium sulphate, hydrogen-disodium phosphate, &c., to the acid salts. Basic salts are as a rule best designated merely by their formulae.

"4. Use names such as *methane*, *ethane*, &c., for the normal paraffins or hydrocarbons of the $\text{C}_n\text{H}_{2n+2}$ series of the form $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$. The isomeric hydrocarbons are usually most conveniently represented by names indicating their relation to methane: for example, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ = propylmethane; $\text{CH}_3\text{CH}(\text{CH}_3)_2$ = isopropylmethane or trimethylmethane; or, although less frequently, by names such as diisopropyl.

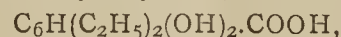
"5. Term the hydrocarbons C_2H_4 and C_2H_2 *ethylene* and *acetylene* respectively (not ethene and ethine). Distinguish the homologues of ethylene, whenever possible, by names indicating their relation to it, such as methyl-ethylene, dimethylethylene, &c., denoting the di-derivatives of the form $\text{C}_n\text{H}_{2n+1}\text{HC}:\text{CH}.\text{C}_n\text{H}_{2n+2}$ as α -, and those of the form $\text{CH}_2:\text{C}(\text{C}_n\text{H}_{2n+1})_2$ as β -compounds: thus, $\text{CH}_3\text{CH}:\text{CH}.\text{CH}_3$ = α -dimethylethylene; $\text{CH}_2:\text{C}(\text{CH}_3)_2$ = β -dimethylethylene. Similarly, use names such as methylacetylene and dimethylacetylene for the homologues of acetylene of the form $\text{CH}:\text{C}.\text{C}_n\text{H}_{2n+1}$ and $\text{C}_n\text{H}_{2n+1}\text{C}:\text{C}.\text{C}_n\text{H}_{2n+1}$. Adopt the name *allene* for the hydrocarbon $\text{CH}_2:\text{C}:\text{CH}_2$, and indicate the relation which its homologues bear to it in the same manner as pointed out for acetylene.

"6. Distinguish all alcohols, *i.e.*, hydroxyl-derivatives of hydrocarbons, by names ending in *ol*, *e.g.*, quinol, catechol, resorcinol, saligenol, glycerol, erythrol, mannitol, instead of hydroquinone, pyrocatechin, resorcin, saligenin, glycerin, erythrite, mannite. Compounds which are not alcohols, but which are at present distinguished by names ending in *ol*, may be represented by names ending in *ole*, if a systematic name cannot be given. For example, write indole instead of indol; furfuraldehyde instead of furfural; fucusaldehyd instead of fucosol. Ethers derived from phenols, such as $\text{C}_6\text{H}_5.\text{OCH}_3$, &c., hitherto called

anisol, anethol, &c., may be distinguished by names ending in *oil*, as anisoil and anethoil.

"Alcohols should be spoken of as mono-, di-, tri-, or *n-hydric*, according to the number of OH groups.

"7. Bodies such as the acids of the lactic series containing the group (OH) should be termed *hydroxy*-, and not oxy-derivatives, *e.g.*, hydroxyacetic and not oxyacetic acid. Compounds containing the analogous groups, $\text{C}_2\text{H}_5\text{O}$, $\text{C}_6\text{H}_5\text{O}$, CH_3COO , &c., should in like manner be termed ethoxy-, phenoxy-, acetoxy- derivatives. Thus ethoxy-propionic acid instead of ethyllactic acid; 3:4 diethoxybenzoic acid instead of diethylprotocatechuic acid; and acetoxypropionic acid instead of acetyllactic acid. Terms such as diethylprotocatechuic acid should be understood to mean a compound formed by the displacement of hydrogen-atoms in the hydrocarbon radicle of protocatechuic acid by ethyl, viz.,—



and not $\text{C}_6\text{H}_3(\text{OC}_2\text{H}_5)_2.\text{COOH}$, just as dibromoprotocatechuic acid is understood to be the name of a compound of the formula $\text{C}_6\text{HBr}_2(\text{OH})_2.\text{COOH}$.

"8. The term *ether* should be restricted to the oxides of hydrocarbon radicles, and the so-called compound ethers should be represented by names similar to those given to the analogously constituted metallic salts (comp. 12).

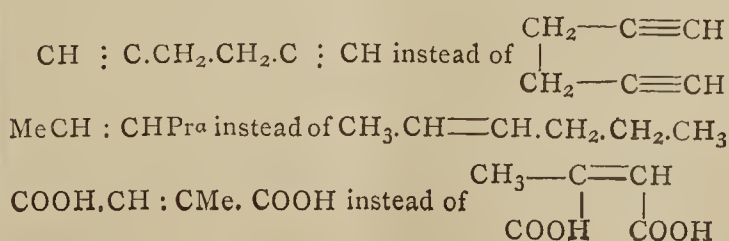
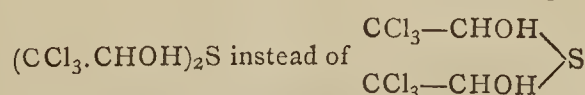
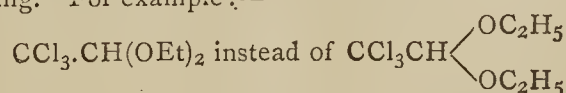
"9. Compounds of the radicle SO_3H should, whenever possible, be termed *sulphonic acids*, or, failing this *sulpho-compounds*: as benzene sulphonic acid, sulphobenzoic acid, and not sulfi-compounds. Compounds of the radicle $\text{SO}_2.\text{NH}_2$ should be termed *sulphonamides*.

"10. Basic substances should invariably be indicated by names ending in *ine*, as aniline, instead of anilin, the termination *in* being restricted to certain neutral compounds, viz., glycerides, glucosides, bitter principles, and proteids, *e.g.*, palmitin, amygdalin, albumin. The compounds of basic substances with hydrogen chloride, bromide, or iodide, should always receive names ending in *ide* and not *ate*, as morphine hydrochloride and not morphine hydrochlorate.

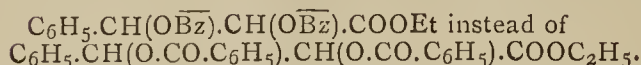
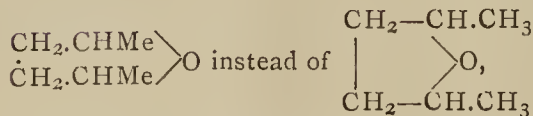
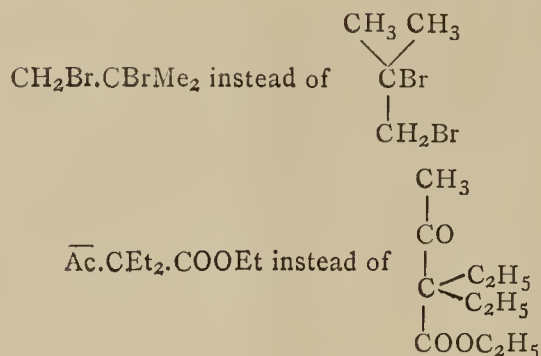
NOTATION.

"11. Equations, as a rule, should *not* be written on a separate line, but should 'run on' with the text. Simple reactions involving a mere interchange of radicles, or the withdrawal or addition of a particular element or group of elements, need not generally be expressed by equations.

"12. To economise space it is desirable:—1, that *dots* should be used *instead of dashes* in connecting contiguous symbols or radicles, whenever this does not interfere with the clearness of the formula; 2, that formulae should be shortened by the judicious employment of the symbols Me for CH_3 , Et for C_2H_5 , Pr α for $\text{CH}_2\text{CH}_2\text{CH}_3$, Pr β for $\text{CH}(\text{CH}_3)_2$, Ph for C_6H_5 , Ac for $\text{CO}.\text{CH}_3$, and Bz for $\text{CO}.\text{C}_6\text{H}_5$; and 3, that formulae should be written *in one line* whenever this can be done without obscuring their meaning. For example:—

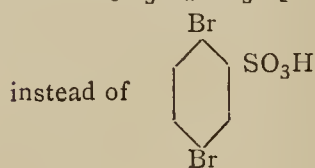
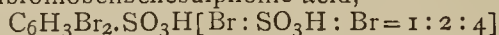


* See CHEMICAL NEWS, vol. xxxix, p. 146.



"13. In representing the constitution of benzene derivatives, as a rule, merely indicate the relative positions of the radicles in the symbol of benzene by figures, instead of by means of the hexagon symbol, as in the following example:—

Paradibromobenzenesulphonic acid,—



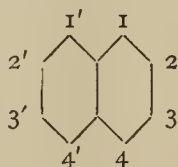
the figures always being used in the order



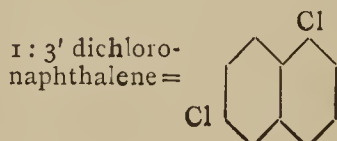
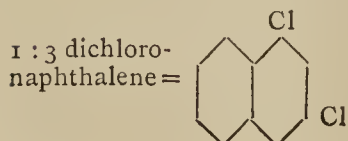
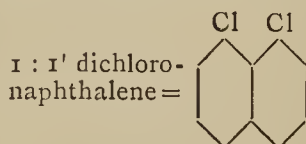
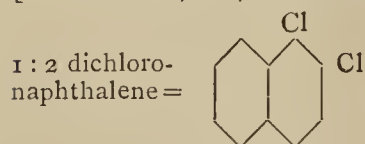
Relatively to the position 1, the positions 2 and 6 should always be spoken of as *ortho*-positions, 3 and 5 as *meta*-positions, and 4 as the *para*-position. It is better, however, in speaking of the derivatives of benzene, to express their constitution by giving them names such as 1 : 2 dibromobenzene, 1 : 3 dibromobenzene, &c., rather than by terming them *ortho*- or *meta*-dibromobenzene, &c.

"14. In representing the constitution of derivatives of other 'closed chain' hydrocarbons also, as a rule, do not employ graphic formulæ, but merely indicate the position of the radicles introduced, in the following manner:—

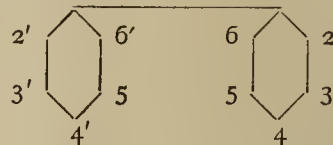
"In the case of *naphthalene*, express the position of the radicles introduced in place of hydrogen relatively to the carbon atoms common to the two 'rings,' and number the positions in the one ring 1, 2, 3, 4, and those in the other 1', 2', 3', 4' in the order shown by the annexed symbol:—



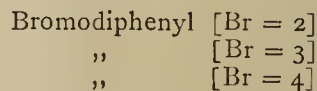
"The dichloronaphthalenes, for example, are spoken of simply as 1 : 2 dichloronaphthalene, or dichloronaphthalene [Cl : Cl = 1 : 2, &c., thus:—



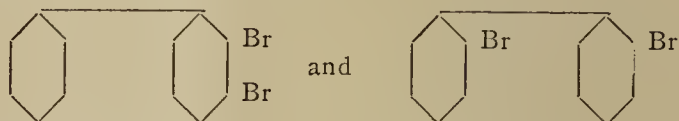
"In the case of *diphenyl*, indicate the position of the radicles relatively to the carbon atom of one C₆ group which is associated with the other C₆ group, and number the positions in the one group by the figures 2, 3, 4, 5, 6, and the corresponding positions in the other group by the figures 2', 3', 4', 5', 6', as shown by the following symbol:—



Thus the mono-derivatives, the bromodiphenyls, for example, are represented as—

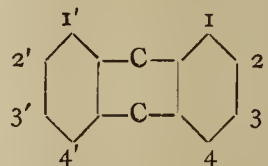


and the two dibromodiphenyls—



are respectively dibromodiphenyl [Br : Br = 2 : 3] and dibromodiphenyl [Br : Br = 2 : 6'].

"In the case of *anthracene*, employ the following symbol, and indicate the position of the radicles relatively to the central C₂-group:—



Examples:—

Alizarin, C₆H₄ : C₂O₂ : C₆H₂(OH)₂ [OH : OH = 1 : 2].

Quinizarin, C₆H₄ : C₂O₂ : C₆H₂(OH)₂ [OH : OH = 1 : 4].

Anthraflavic acid,—

C₆H₃(OH) : C₂O₂ : C₆H₃(OH) [OH : OH = 2 : 3'].

Purpurin,—

C₆H₄ : C₂O₂ : C₆H(OH)₃ [OH : OH : OH = 1 : 2 : 4].

"In speaking of compounds such as these, their constitution may be represented by the names—

1 : 2 Dihydroxyanthraquinone = Alizarin.
1 : 4 " = Quinizarin.
2 : 3' " = Anthraflavic acid.
1 : 2 : 4 Trihydroxyanthraquinone = Purpurin.

"Always include the letters and figures indicating the constitution of derivatives of closed chain hydrocarbons in square brackets."

SEPARATION OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

(Continued from p. 3.)

Separation from Silver.—1. In a very acid nitric solution the silver is removed by a slight excess of hydrochloric acid.

2. Sulphuretted hydrogen completely removes the silver contained in nitric solutions moderately acid, or in strongly acid hydrochloric liquids.

Separation from Gold.—The three following procedures are recommended:—

1. A current of sulphuretted hydrogen is passed into the decidedly acid solution.

2. The gold is reduced at a gentle heat by sulphurous acid and the precipitate washed with water acidified with a little hydrochloric acid.

3. The hydrochloric solution, decidedly acid, if brought in contact with divided copper, abandons the gold and retains the gallium. The operation takes place either in the cold or at a gentle heat.

Separation from Palladium.—The author has examined four methods, the two first of which give exact results.

1. The best process is to treat the decidedly acid hydrochloric solution with a prolonged current of sulphuretted hydrogen. The formation of palladium sulphide is slow in dilute solutions. After saturation with sulphuretted hydrogen in the cold, the liquid is kept for about a couple of hours at about 70°, and it is then ascertained that the filtrate, on submission to the same treatment, does not become coloured. It is advantageous to operate upon concentrated liquids, and to concentrate by evaporation before the final treatment with sulphuretted hydrogen, thus expelling the too great excess of hydrochloric acid.

2. Divided copper is placed in a moderately acid hydrochloric solution. In the cold the reduction of the palladium is complete, but slow, and it is better to operate about 80°. The palladium obtained is free from gallium, or contains sometimes an insignificant trace. Nevertheless, palladium reduced by zinc, as is mentioned below, retains energetically a small quantity of gallium. In view of this discrepancy, and fearing an error, the author effected repeated and carefully the reduction of palladium by means of copper in liquids containing gallium, and on each occasion the absence of copper in the precipitate was ascertained. The palladium is deposited upon the copper in brilliant, compact layers, and during the reaction there is no escape of gas. Zinc, on the contrary, occasions a brisk escape of hydrogen, and the palladium appears in the form of a black powder, of porous aspect, acting perhaps upon the salts of gallium as does animal charcoal upon certain soluble bodies. Perhaps the hydrogenation of the reduced metal plays a part in the phenomenon observed.

3. Zinc quickly throws down palladium from a distinctly acid hydrochloric solution, but the reduced metal, though washed in water acidified with hydrochloric acid, retains a little gallium.

In one experiment, 0.005 grm. gallium and 0.25 grm. palladium were brought into the state of very acid chlorides. In contact with zinc the solution yielded a metal containing a portion of gallium. This galliferous palladium, transformed into a chloride, was again treated in the same manner. The new precipitate, still containing sensible traces of gallium (though less than the first) was again converted into chloride and submitted to the action of zinc. The last metal still retained gallium, the quantity of which was merely diminished from the first to the third precipitation.

4. Palladium is often separated from other metals by evaporating the solution in *aqua regia* almost to dryness, after the addition of potassium chloride. The mass is then re-dissolved in alcohol of 85 per cent. This process, convenient in certain cases only, permits of an approximate analysis of mixtures of palladium and gallium, since sensible traces of gallium remain in the potassium palladio-chloride, and of palladium in the alcoholic liquid.

Separation from Platinum.—The only exact process is the precipitation of platinum by sulphuretted hydrogen in a decidedly acid hydrochloric solution. The formation of platinum sulphide is very slow, especially in the cold, but it may be accelerated by heating. We may saturate with sulphuretted hydrogen in the cold and raise the liquid slowly to near boiling, repeating this treatment eight or ten times in succession. Or after having saturated the liquid with sulphuretted hydrogen in the cold it is heated to about 70°, and kept at this temperature for some hours, whilst still traversed by a slow current of sulphuretted hydrogen.

The filtered solution is then mixed with the washing waters and concentrated, thus eliminating the bulk of the hydrochloric acid, a little of which in the free state ought to remain. It is then treated with sulphuretted hydrogen

for some hours in heat; if there is no colouration the platinum has been entirely eliminated.

2. An approximate separation is obtained by precipitating the platinum with ammonium chloride in a hydrochloric solution, distinctly acid, and mixed with alcohol. The filtrate carries off a little platinum, but the ammonium platino-chloride does not appear to retain appreciable quantities of gallium.

3. Copper reduces the platinum, but it is difficult to obtain a complete reaction even in heat. On the contrary, a distinctly acid solution of platinum chloride is entirely reduced by zinc, the action being much more rapid in heat than in the cold. A few drops of hydrochloric acid are added from time to time to keep up a brisk escape of hydrogen. The platinum thus precipitated retains gallium with a persistence even exceeding that mentioned above in the case of palladium. The reduction with zinc must be repeated a great many times in order to remove all the gallium. The use of zinc is therefore very inferior to that of sulphuretted hydrogen.—*Comptes Rendus*, vol. xcv., p. 1332.

NOTE ON ASBESTOS FILTERS.

By P. CASAMAJOR.

AN extensive dealer in wares used by chemists lately informed me that he had many inquiries concerning asbestos for filtering liquids in chemical analysis. Some chemists complain that they cannot get clear solutions through asbestos, while others, who obtain clear solutions, find that their liquids filter altogether too slowly.

Allow me to recall that the method of making asbestos filters, by pouring a thin paste of this material over a perforated platinum disc, was first proposed by me in 1875,* but I neglected to give directions concerning the preparation of asbestos, to make it fit for filtering liquids in chemical analysis. It now appears, however, that such directions would be found useful, and I propose to repair the omission and give the necessary details.

The kind of asbestos to use is a matter of some importance. I have tried three kinds, which are sold by dealers in New York as the *Canadian*, the *Italian*, and the *Australian*. This last is less flexible than the other two, and consequently the fibres do not felt together and pack as closely on the perforated plate. Hence liquids filter more rapidly, and the Australian is, on this account, preferable to the other two kinds. I am informed that the Canadian asbestos is the most soluble in acids, but I have not verified the assertion.

Whatever may be the kind of asbestos used the following is a process for obtaining, with little trouble, a quantity of the pulp in a fit state for filtration:—

A coarse brass sieve is placed over a sheet of paper, and a handful of asbestos is rubbed pretty roughly over the sieve cloth. This breaks it up in such a way that the smaller fragments pass through the meshes, and are deposited on the paper underneath. After a while the portion which remains on the sieve cloth is collected in one bundle, and rubbed again in the same manner, and the operation is repeated until a sufficient quantity has gone through. In a few minutes enough of the material is obtained to last for months.

As to the coarseness of mesh to use, I may say that I have used No. 10 sieve (ten openings to the inch) with satisfactory results. The sieve is best placed bottom up, so as to leave plenty of room under the cloth.

The next operation is to free the sifted material from dust, and from the finest particles. This is easily accomplished by placing the asbestos, as obtained above, over another sieve of finer mesh (about No. 25 or No. 30), and stirring it while water is poured over the sieve. The first

* See *American Chemist*, v., p. 44; *CHEMICAL NEWS*, xxxii., p. 46.

water which passes through is quite milky, but it gradually becomes clearer as the washing is continued. The washed asbestos is then put in a beaker glass, and boiled for about half an hour with strong hydrochloric acid (about 1 part of fuming HCl to 4 parts of water).

The pulp, after this treatment, is poured over a perforated platinum plate placed in a funnel,* and washed with distilled water until no acidity is shown by litmus-paper. The pulp is then taken out of the funnel and strongly heated in a platinum dish. After letting it cool sufficiently it may be placed in a wide-mouth bottle for future use.

DETERMINATION OF THE FOREIGN ELEMENTS CONTAINED IN "WORK COPPER."

By Prof. R. FRESENIUS.

1. Treat 100 grms. of the carefully cleaned sample with a sufficiency of pure nitric acid of sp. gr. 1.20—adding water in case of copper turnings—until no further action takes place in heat, dilute with water, filter and wash the undissolved residue. The filtrate is collected in a tared measuring-flask holding 2 litres.

2. The residue is washed into a porcelain capsule, the ash of the filter is added; the whole is evaporated to dryness, placed in a porcelain crucible, any particles adhering to the capsule being rubbed off with sodium carbonate and added to the rest. Sodium sulphide is added, the whole fused, with exclusion of air, and treated with water when cold; the yellow solution is filtered from the black residue, and the latter is washed.

3. The black residue obtained in No. 2, together with the filter, is heated with moderately dilute nitric acid, filtered, washed, the filter burnt, the ash heated with nitric acid, diluted, filtered, the filtrate mixed with the solution previously obtained, the filter is incinerated, and the ash—which may contain a portion of gold—is preserved. The solution is mixed with a little hydrochloric acid. If a precipitate of silver chloride is formed it is let deposit, filtered, and converted into metallic *silver*, which must ultimately be tested as to its purity. The solution, after removal of the silver chloride, if any, is evaporated along with sulphuric acid for the separation of *lead*. From the filtrate *bismuth*, if present, is thrown down by means of sulphuretted hydrogen, and from the filtrate any metals of the fourth group are precipitated with ammonium sulphide.

4. The sulphide solution obtained in No. 2 is precipitated with hydrochloric acid; the precipitate, containing much sulphur, is treated, along with the filter, with hydrochloric acid containing bromine, till everything soluble is dissolved. Filter, wash, remove any free bromine by means of ammonia, acidify with hydrochloric acid, precipitate at 70° with sulphuretted hydrogen, separate the metallic sulphides by precipitation, dissolve them in slightly yellowish ammonium sulphide, filter, evaporate the solution to dryness in a porcelain crucible, oxidise the residue carefully with fuming nitric acid, evaporate to dryness, add sodium hydrate and a little sodium nitrate; melt and separate antimony, tin, and arsenic, if all present, according to H. Rose's method. The small filters in which the solution of the metallic sulphides in ammonium sulphide, and the solution of sodium antimoniate in hydrochloric and tartaric acids have been filtered, are incinerated after washing, and the ash, mixed with that previously reserved, is treated with *aqua regia*. Dilute, filter, evaporate with hydrochloric acid to expel the nitric acid, and from the residue concentrated to a small volume

precipitate gold by means of ferrous chloride. If tin is not present, antimony and arsenic are better separated according to Bunsen's method, in the solution obtained by brominised hydrochloric acid after removing the free bromine with ammonia. In this case the weighed metallic sulphides must be tested for gold.

5. One litre of the liquid obtained in No. 1, corresponding to 50 grms. copper, is mixed with 4 drops of hydrochloric acid. If a turbidity or a deposit of silver chloride is formed, it is allowed to settle while hot, and a further drop of hydrochloric acid is added, observing if all the silver is precipitated. If a turbidity is occasioned a few more drops of hydrochloric acid must be added, avoiding any appreciable excess. The silver chloride is most conveniently converted into metallic silver for weighing. The quantity found, if doubled and added to that obtained in No. 3, gives the percentage of silver.

6. The solution from No. 5 not rendered turbid by hydrochloric acid, or filtered from a precipitate of silver chloride, is placed in a porcelain capsule, cautiously mixed with 85 grms. pure concentrated sulphuric acid, which has been previously diluted with water, evaporated till all nitric acid is expelled, mixed with water, heated till all the copper sulphate is dissolved, and the liquid then filtered into a 2-litre measuring-flask. The undissolved residue of lead sulphate is washed, first with water containing sulphuric acid, and then with alcohol, which is collected separately. It is then weighed, and tested for its purity by boiling it with a solution of ammonium acetate containing a little free ammonia. If an insoluble residue is left after repeated boiling it must be deducted from the lead sulphate and further examined.

7. The solution obtained in No. 6, separated from the lead sulphate by filtration, is made up to 2 litres, mixed, $\frac{1}{2}$ litre of the solution is introduced into each of four boiling-flasks, containing $1\frac{1}{2}$ litre, the contents of each are diluted with about $\frac{1}{2}$ litre water, and to each is added 50 c.c. hydrochloric acid of sp. gr. 1.12. They are heated to 70°, and the copper is precipitated with sulphuretted hydrogen. The contents of the four flasks, when cold, are introduced into a tared 6-litre flask with a ground stopper: the boiling-flasks are repeatedly rinsed out with sulphuretted hydrogen water, so that their entire contents are brought into the large flask which after thorough mixing is weighed. If from the gross weight is deducted that of the empty flask and that of the copper sulphide (as calculated from the metallic copper), we obtain the weight of the solution in the flask. After the precipitate has settled, the supernatant liquid is drawn off as completely as possible: the flask with the precipitate and the remainder of the solution is weighed, and the weight of the liquid drawn off is thus found. The latter is filtered, evaporated in a porcelain capsule until the sulphuric acid is nearly all driven off; heated again with a little nitric acid, mixed with ammonia, filtered, the residue dissolved in hydrochloric acid, and again precipitated with ammonia. In the precipitate any *iron* present is determined preferably by precipitation with ammonium sulphide from the solution mixed with tartaric acid and ammonia, and converting the iron sulphide into iron oxide in the ordinary manner. From the filtrate, after addition of ammonium acetate and acidulation with acetic acid, *nickel*, *cobalt*, and *zinc* are precipitated, if present, and separated and determined as usual. The quantities of iron, nickel, cobalt, and zinc present in the whole of the solution are then calculated.

8. To the precipitate, together with the residue of the solution left in the large flask, is added caustic soda-lye till the liquid has a strong alkaline reaction. A solution of sodium sulphide containing some disulphide is then added in sufficient quantity, so that all antimony and arsenic sulphides may be dissolved, and the whole is gently heated for some time. It is then considerably diluted with water, mixed, weighed; the liquid is drawn off as far as possible, the flask with the rest of its contents is weighed, and the quantity of the liquid drawn off is thus ascertained. It is filtered, acidulated with hydrochloric acid,

* A perforated platinum disc, having a stout platinum wire soldered with gold in the centre of the disc, can be used in an ordinary conical funnel. The wire finds its place in the stem of the funnel, and keeps the perforated plate in position. (See CHEMICAL NEWS, xlvii, p. 8.) A Gooch crucible of sufficient size may also be used for the same purpose.

and let settle. As has been laid down in No. 7, it is easy to calculate the quantity of copper from which the metallic sulphides of the sixth group precipitated from the solution containing the alkaline sulphides are derived. As they are mixed with a large excess of sulphur, the precipitate, after settling, is filtered, washed, treated whilst still moist with hydrochloric acid containing bromine, diluted, filtered, mixed with ammonia till the solution has become colourless, and then, after a gentle but prolonged heating, with hydrochloric acid. From the clear solution the metals of the sixth group are precipitated by means of sulphuretted hydrogen and separated, as recommended in No. 4. The quantities obtained are calculated for the whole weight.

9. The precipitate of copper sulphide obtained in No. 8 from the main quantity of the liquid containing the alkaline sulphides is brought upon the filter through which the liquid has been passed, washed with water containing sodium sulphide, dissolved in hydrochloric acid with the addition of nitric acid, and filtered, the solution, with the addition of hydrochloric acid in excess, is evaporated to dryness upon the water-bath, the saline mass taken up in water, and filtered. The insoluble residue containing all the bismuth as a basic chloride is dissolved in hydrochloric acid, potassa is added until the liquid is alkaline, then potassium cyanide in some excess, and potassium sulphide. The bismuth is separated as sulphide, whilst the copper entangled with it remains in solution. As the bismuth sulphide may contain nickel sulphide, it is dissolved in nitric acid, the diluted solution precipitated with sulphuretted hydrogen, and the pure bismuth sulphide is either weighed as such, or converted into bismuth oxide.

10. 400 c.c. of the solution obtained in No. 1, representing 20 grms. copper, are mixed with ammonia till the greater part of the free nitric acid is neutralised. A few drops of solution of barium nitrate are added, and the whole is let stand for some time in a warm place. If the copper contains appreciable traces of sulphurous acid there appears a slight precipitate of barium sulphate, which is filtered off, and determined. Very minute traces of sulphurous acid cannot be discovered in this manner, since barium sulphate is not quite insoluble in the solution of copper nitrate. For detecting very small quantities the copper must therefore be treated according to Hampe's directions in a current of chlorine. In constructing the apparatus vulcanised caoutchouc tubing is inadmissible.

11. 400 c.c. of the solution in No. 1, representing 20 grms. copper, are repeatedly evaporated with hydrochloric acid, in order to expel nitric acid, diluted with 1200 c.c. of water, precipitated with sulphuretted hydrogen at 70°; the whole introduced into a tared 2-litre flask, into which the capsule is rinsed, and the liquid is mixed and weighed. It is let settle, as much as possible of the supernatant liquid is drawn off, the flask with the precipitate and the residue of the solution is weighed, thus showing what quantity of copper corresponds to the liquid drawn off (compare No. 7). It is filtered, evaporated to a small volume with repeated additions of nitric acid, and any phosphoric acid present (due to the presence of phosphorus in the copper) is determined by the molybdc process.

12. For the determination of oxygen and for ascertaining the state of combination of the foreign elements, the author refers to Hampe's memoir in the *Zeitschrift für Berg. und Hütten Wesen*, 27, p. 205.—*Zeitschrift für Analyt. Chemie*, 21, p. 229.

Determination of Proximate Constituents.—For the determination of the free acids in fatty oils Burstyn and Langier have proposed methods which consist in extracting the free acid by agitation with alcohol at 90 per cent and titrating the solution. The assumption that the oil entirely dissolves in the alcohol is incorrect. Hofmann and Geissler propose to dissolve the oil in ether and to titrate with an alcoholic solution of potassa.—*Zeitschrift*.

NEW VOLUMETRIC DETERMINATION OF POTASSIUM DICHROMATE, AND ITS USE IN THE TITRATION OF THE CAUSTIC ALKALIES.

By M. RICHTER.

Potassium dichromate is an acid salt, and in contact with caustic potassa passes into 2 mols. of the monochromate.

The dichromate to be examined is dissolved in water, and mixed with very little phenol phthaleine, which separates out as it is dissolved in alcohol. Large quantities of phenol phthaleine are to be avoided as the final reaction would be delayed.

In titration, a potassa solution must be used which has been standardised with sulphuric acid, and the action of which in comparison with sodium carbonate has been determined with phenol phthaleine, for the litmus colour is not sufficiently sensitive and distinct.

As the potassa falls into the solution of the dichromate the orange colour of the latter passes first into the yellow of the monochromate, and then, as in the titration of chlorine with a silver solution, each drop of the potassa produces a red spot which disappears on gentle agitation. At the conclusion of the reaction the red colour remains decidedly longer. It must not be supposed that the titration is at an end, for this phenomenon depends merely on the suspension of the phenol phthaleine in the liquid. We cease with a faint yellowish red colouration and use as comparison a solution of the monochromate of the same degree of concentration (1 gm. in 150 to 200 grms. water). The transit from the full yellow to the reddish yellow colour is easily recognised. By means of this method of determining chromic acid in alkaline dichromates, and of the author's process for its titration in the monochromate with silver nitrate and back-titration with sodium chloride, it is possible to determine mono- and dichromates when they occur together. The method is more than sufficiently accurate for technical purposes.

The author recommends the inverse use of this method, employing potassium dichromate for titrating potassa, soda, and ammonia. Two advantages of this method are that the dichromate occurs pure and anhydrous, and that the solution retains its standard for years.—*Zeitschrift für Anal. Chemie*.

NOTE ON THE AMMONIA-PROCESS FOR WATER ANALYSIS.

By CHARLES W. MARSH.

THE present article contains the results of some investigations in connection with the systematic examination and comparison of various methods of water analysis. Among other questions presented for examination was that of the possible loss of volatile organic matter during the evaporation and boiling of water, necessitated by the ammonia and other processes. At the suggestion of Prof. Cornwall the series of experiments in Table I was begun last fall. After the experiments had been nearly completed, a copy of a "Report on a Peculiar Condition of the Water of Boston in November, 1881," by Prof. Ira Remsen, was received, in which it was found that Prof. Remsen had already anticipated the results here given in his report, in which he says: "Another fact which came out in the examination of the Baltimore water was this: When free and 'albumenoid ammonia' were determined by the method already described, the amounts of the two added together were found to be considerably smaller than the total ammonia found when the oxidising mixture was added at the beginning of the operation, before the water was boiled. This clearly indicated that in the first stage

of the process, as usually conducted, there passed over with the free ammonia some nitrogenous substance capable of yielding ammonia with permanganate of potash. As this distillate had a strong odour, something like the 'cucumber odour,' the suggestion was made that the odour of the water was due to the presence of some volatile nitrogenous substance, the special nature of which could not be determined. The examination of the Farm-pond water confirms this idea. One example will make this clear, and will suffice: a specimen of Farm-pond water gave, when examined in the usual way, 0.034 free and 0.274 albumenoid ammonia, making a total of 0.308 parts of ammonia in 1,000,000 parts of water. When the same water was treated at the outset with the oxidising mixture, it gave a total of 0.506 part of ammonia. There remains here the difference between 0.308 and 0.506 to be accounted for, or two-fifths of the total. The material capable of yielding this lost ammonia was undoubtedly lost in the distillations of the water for free ammonia, and it must hence be a volatile nitrogenous substance."

The analyses in Table I. may still prove of interest, both as verifying his statement and illustrating the great variability in the proportion of organic matter which may thus be lost. Twenty-six analyses were made on different waters, proceeding in the following manner:—The analysis for free and albumenoid ammonia was made as Wanklyn directs. Then 300 c.c. were taken (the same quantity remaining in the retort when the permanganate of potash is added in the regular analysis), and 50 c.c. of permanganate were added, and three distillates of 50 c.c. each were taken off and nesslerised, and the whole calculated to 1 litre. This gave the total ammonia. In only one case did the sum of the free and albumenoid ammonia exceed the total ammonia. In three cases the results were identical, and in the other twenty-two the total ammonia was more than the sum of the free and albumenoid ammonia. In Table I. in the first column is the free ammonia; in the second the albumenoid ammonia; in the third the sum of the two; in the fourth the total ammonia; and in the fifth the difference between the total ammonia and the sum of the free and albumenoid ammonia.

TABLE I.

No.	Specimen.	Free Ammonia.	Albumenoid Ammonia.	Sum of Free Ammonia and Albumenoid Ammonia.	Total Ammonia.	Difference bet. Sum of Free Ammonia and Albumenoid Am. and Total Am.
1	Well Water	0.04	0.15	0.19	0.29	0.10
2	" "	0.05	0.20	0.25	0.35	0.10
3	" "	0.05	0.10	0.15	0.18	0.03
4	Cistern "	0.01	0.07	0.08	0.10	0.02
5	" "	0.01	0.06	0.07	0.07	0.00
6	" "	0.09	0.07	0.16	0.18	0.02
7	Well "	0.46	0.07	0.53	0.56	0.03
8	Canal "	0.01	0.20	0.21	0.21	0.00
9	Distilled water	0.36	0.03	0.39	0.49	0.10
10	Well Water	0.01	0.04	0.05	0.07	0.02
11	" "	0.06	0.08	0.14	0.16	0.02
12	Spring "	0.06	0.08	0.14	0.15	0.01
13	Surface "	8.10	1.75	9.85	10.12	0.27
14	" "	2.84	1.46	4.30	4.10	*0.20
15	" "	8.48	2.12	10.60	11.11	0.51
16	Cistern "	0.07	0.08	0.15	0.18	0.03
17	Well "	0.02	0.16	0.18	0.20	0.02
18	" "	0.02	0.07	0.09	0.10	0.01
19	" "	0.01	0.02	0.03	0.07	0.04
20	Spring "	0.01	0.02	0.03	0.06	0.03
21	Well "	0.02	0.03	0.05	0.06	0.01
22	" "	0.11	0.11	0.22	0.24	0.02
23	" "	0.01	0.04	0.05	0.10	0.05
24	" "	0.16	0.11	0.27	0.34	0.07
25	" "	0.07	0.08	0.15	0.20	0.05
26	" "	0.04	0.08	0.12	0.12	0.00

The ammonia is expressed in parts per million.

It will be seen from the table that No. 14 was the only water where the sum of the free and albumenoid ammonia was greater than the total ammonia. This exceptional result may well be ascribed to the greater difficulty of accurately estimating the ammonia in highly coloured nesslerised solutions, and to the fact that any actual errors of this kind were increased in calculating the results, since it was necessary to dilute the specimen very largely with water free from ammonia. In Nos. 5, 8, and 26 it appears that no volatile nitrogenous substance escaped, as will be seen from the last column. All the other waters show different amounts of gain of the total ammonia over the sum of the free and albumenoid ammonia, some slight and some comparatively very large. The results in the table conclusively prove that something escapes conversion into ammonia. Is this something which escapes condensation, or will it be found in the distillate? To decide this question 500 c.c. of the water were boiled as usual to obtain a distillate of 200 c.c., containing, according to Wanklyn, all the free ammonia. This distillate was re-distilled with a proportionate amount of permanganate (33 c.c.), and two distillates of 50 c.c. each were obtained and nesslerised, the result being doubled to bring it up to one litre. This gave all the free ammonia and any ammonia which may come from the action of the permanganate on any condensible nitrogenous, organic compound, which had come over with the free ammonia. The ammonia from these two sources is given in the next to the last column Table II. In this table are the results of analysis on ten samples of water. In the first four columns the data are the same as in Table I. In the fifth column is the free ammonia and the ammonia which we have regained. In the sixth column is the sum of the albumenoid ammonia and the ammonia in the fifth column.

TABLE II.

No.	Specimen.	1. Free Ammonia.	2. Albumenoid Ammonia.	3. Sum of Free Am. and Albumenoid Am.	4. Total Ammonia.	5. Sum of Free Am. and Regained Am.	Sum of 2 and 5.
1	Well Water	0.04	0.10	0.14	0.19	0.06	0.16
2	" "	0.05	0.10	0.15	0.16	0.06	0.16
3	" "	0.05	0.08	0.13	0.17	0.09	0.17
4	" "	0.04	0.07	0.11	0.12	0.06	0.13
5	" "	0.04	0.07	0.11	0.12	0.05	0.12
6	" "	0.05	0.22	0.27	0.27	0.05	0.27
7	" "	0.03	0.12	0.15	0.17	0.06	0.18
8	" "	0.04	0.03	0.07	0.08	0.05	0.08
9	Cistern "	0.05	0.11	0.16	0.22	0.08	0.19
10	Well "	0.02	0.08	0.10	0.15	0.07	0.15

The ammonia is expressed in parts per million.

It would appear that in the case, at least, of specimens Nos. 2, 3, 5, 6, 8, and 10, the excess of ammonia obtained where the whole of the water was distilled with the permanganate, directly, over the sum of the free and albumenoid ammonia as usually obtained, was due to some volatile, condensible, nitrogenous compound, from which as much ammonia could be obtained by the action of boiling permanganate after its distillation from the original water, as before. In Nos. 1 and 9 the sum of the albumenoid ammonia and the ammonia from the re-distillation is less than the total ammonia, hence some of the constituents escaped in the first distillation. In Nos. 4 and 7 the sum of the two ammonias in the sixth column is slightly greater than the total ammonia, which may be due to error of reading; at all events these two waters would show that all the ammonia was regained.

It is possible that the modification of the usual ammonia-process which is obviously suggested by the foregoing experiments may reconcile the differences now existing

between the organic purity of water as determined by the ammonia-process, and the oxidation process with permanganate (Forchhammer's and its modifications). Work in this direction is now going on.—*American Chemical Journal*, vol. iv., No. 3.

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REPORTS ON THE EXAMINATION OF THAMES WATER.*

It will add to a clear understanding, in following the reports on the examination of Thames water, to forestall a statement respecting the results towards which "examination" is now directed, since it is only after reading through the special reports between 1828 and 1874, and the continuous reports to the Registrar-General since 1857, and the many others incorporated in the reports of the Water Examiner since 1873, that it becomes apparent what are the points which are held to be the most important to determine. It is now considered that the most important calculation that has to be made is the amount of organic matter, of animal origin, present in the water. Most of the early analyses of waters, even after the foundation of the Chemical Society in 1841, are those of natural "mineral waters," and the organic matter is generally considered to be sufficiently accurately determined by reference to "a trace." When the Thames water was first officially analysed by Dr. Bostock, and by Dr. Lamb for the Royal Commission of 1827,† the former dismisses organic matter with this remark:—"The remainder" (after the saline matters in a residue have been calculated) "may be considered as consisting of animal and vegetable remains." Dr. Lamb, however, though not seeing how to do more than Dr. Bostock did, has recorded his own, and probably other, chemical opinions in this form:—"It appears to be acknowledged that, in the examination of the properties of a water applied to dietetic uses, the principal object of enquiry should be whether the water, being impregnated with organic matter in a state of decomposition, this matter may be either of vegetable or animal origin; but I do not know that we possess any criterion to determine, with absolute certainty, whether matter, which may be discovered, and which is decidedly of organic origin, was derived originally from one or the other of these species." This, the first recorded recognition of the importance, though written fifty-five years ago, might equally well have been written this year only. The "absolute certainty" is a degree of certainty now, of necessity, from the refinement of modern appliances, very different from what it was then, but the very improvements in methods and manufacture of apparatus and manipulative accuracy have shown the uncertainties of progressive expected certainties, and the "absolute certainty" is not yet reached. One of the greatest points of interest in tracing the history of water analysis is the development of the methods for attempting to determine the amount of organic matter in a water, and more recently the attempts to determine whether what is present is of animal or vegetable origin. And this, too, is of interest to observe the lapse of time that has occurred between the recognition of the need of certain determinations of detail and the invention of a method for making them.

The need for such determinations has come to be shown from a combination of pathological, ætiological, and statistical inquiry, and has now probably a very different significance from what it had for Dr. Lamb.

Forty years later, the same view that Dr. Lamb had was, in "Watts's Dictionary of Chemistry" (1868), expressed:—"The presence of dissolved organic substance in water

has, probably, a much greater influence in determining its fitness for dietetic purposes, &c."

Ten years later still, Dr. Tidy, in a paper read before the Chemical Society (1878), on "The Processes for Determining the Organic Purity of Potable Waters," wrote:—"Without stating definitely that I should be justified in expressing numerically the ratio of animal to vegetable matter by this means, I am not without hopes I shall be able to do so before long with considerable accuracy." Many other analysts have expressed the same opinion of uncertainty with regard to different processes, and no one claims "absolute certainty."

It will be convenient to first state what the reports are, and how and when they have appeared.

Leaving for the present the consideration of the steps which had led up to the examination of the waters of the London companies by order of Act of Parliament, the facts immediately connected with it are these:—

The Metropolis Water Act (1852)* had included the following clause, which was the first attempt at legislation with regard to the quality of water the companies should supply (Clause 4):—"From and after the thirty-first day of December, one thousand eight hundred and fifty-four every company shall effectually filter all water supplied by them within the metropolis for domestic use, before the same shall pass into the pipes for distribution, excepting any water which may be pumped from wells into a covered reservoir or aqueduct without exposure to the atmosphere, and shall not be afterwards mixed with unfiltered water." The enforcement of this (together with the enforcement as to quantity) depended upon Clause 9, which provided, "If at any time complaint as to the quantity or quality of the water supplied by any company be made to the Board of Trade by memorial in writing signed by not less than twenty inhabitant householders . . . &c., it shall be lawful for the Board of Trade . . . to appoint a competent person to inquire into and concerning the grounds of such complaint, &c." Clauses 12 and 13 provide that if the complaint shall appear well founded, the company shall remove the grounds of such complaint under penalty (Clause 16) of £200, with £100 a month in case of delays.

The two sets of investigations made for the Board of Health in 1856 were to ascertain how far the regulations of the Act had been carried out. The Act, it appears, did not have the desired effect. No definition was given of what "effectually filter" should mean, it is true; but still the water to be supplied was often pronounced by Prof. Frankland, in his monthly reports to the Registrar-General, unfit for domestic use. In Prof. Frankland's annual report for 1870 it is reported that the condition of the water is such as to "almost lead to the conclusion that Clause 4 had been repealed."

A change as to power of examination was made by the Metropolis Water Act, 1871, by which the examination was not left dependent on the complaint of twenty householders. Clause 35 of that Act provided that the Board of Trade may, at any time, if and when they think fit, appoint a competent person to inquire into and report on the quality of the water furnished by any company, notwithstanding that no complaint, &c. [Notice that quantity was not included, and quality was taken to mean more than merely "efficiently filtered."] Clause 36 provides, "There shall be a Water Examiner . . . who shall from time to time, in such manner as the Board of Trade direct, examine the water supplied by any company, in order to ascertain whether or not the company have complied with the requirements of Section IV. of the Metropolis Water Act, 1852, &c., and shall from time to time report, &c.† It will be noticed that Clause 36 applies to examining with reference to "effectual filtration," while

* 15 and 16 Vict., c. 84. "An Act to make better provision respecting the Supply of Water to the Metropolis;" short title, "Metropolis Water Act, 1852."

† Strange as it may appear to some, the official channel for the reports was the Under Secretary of the Railway Department, Board of Trade.

* From the *Journal of the Society of Arts*.

† Royal Commission, 1827 [Roget, Brand, and Telford], on quality and salubrity of water supplied to the metropolis. Report dated April 21st, 1828.

Clause 35 provides vaguely for examination of "quality." It is not apparent whether two officers were intended, whether by "quality" chemical quality was meant, or only quality as regards absence of such suspended matters as efficient filtration should remove. As a matter of practice "the Water Examiner," Colonel Bolton, reports on the filter beds, and on whether water is clear or turbid after filtration, while Prof. Frankland, who reports on the chemical analysis of the waters, also reports on the efficiency of filtration. In the Session of 1882 it was resolved to transfer the power conferred upon the Board of Trade to the Local Government Board. [On Prof. Frankland's reports see below, under Reports to Registrar-General.]

The Reports of the Water Examiner.

The monthly report is given in a tabulated form, in a single sheet, which, since the enlargement in 1873, is about 25 ins. by 20 ins.

The annual reports are to be found in Parliamentary Papers, as appendices in Local Government Board Reports.

Colonel Bolton's reports, therefore, contain the official account of the examinations made to ascertain how far the requirements of Clause 4, of the Act of 1852, have been carried out. They also show how far the constant supply provisions of the Act of 1871 have been adopted. They rest on totally different ground. The requirements of "efficient filtration," whatever that may mean, are imperative. Those of "constant supply" depend upon the proportion of houses in a district which adopt the fittings suitable for the pressure of a constant supply (see Sect. 10, Act of 1871). Constant supply has been referred to in a previous notice. In addition to the official report which Colonel Bolton gives, a number of other matters are referred to in his monthly reports.* For example, in his 1876 report, he states the duties of "Water Examiner," omitting, however, but without explanation why, all reference to the duties as to reporting on constant supply, and then continues—"In addition to inspecting the filter beds and reservoirs, and examining the quality of the water both at the intake and after filtrations at the works, I have included in my reports the following information and particulars, &c., &c." Where an Act of Parliament is not explicit there is always latitude allowed to those who have the practical interpretation of it. The information given, "in addition," is valuable; but there are obvious reasons for drawing a distinction between what is reported as important by the consensus of Parliamentary opinion, and what is reported on individual opinion as of importance. Most competent judges will agree that much of the information so given should be given as a report in accordance with some clause in an Act; but, for the present, that distinction must be drawn.

With regard to the expression "efficient filtration," and in the absence of any definition, Colonel Bolton writes—"Efficient filtration depends upon—

- "1. A sufficient area of properly constructed filter beds, constantly cleaned, and fresh sanded.
- "2. The rate of filtration being controlled and limited to a certain speed.
- "3. The water delivered into the filter beds having been previously stored on subsidiary reservoirs, and the capacity of these reservoirs being such as to avoid the intake of turbid and muddy water during the time of extraordinary floods, which tend to foul and choke the filters."

"The manner of reporting on the efficiency of filtration is to state whether the samples of water examined are clear, slightly turbid, turbid, or very turbid. Nowhere, however, is there any explanation given as to what is the standard or the scale followed.

* As a matter of fact the monthly reports, though referred to in the annual reports, have been apparently nowhere preserved, unless by some unknown collector.

Monthly Reports.

When the monthly reports were commenced, and up to 1876, only one sample a month from each of the companies was examined. In February, 1876, and since then, there have been daily samples of the water of each company reported on in this manner. In addition to this, particulars are given of the area, thickness, and composition of the filter-beds, and the condition of the water at the intakes.

Information respecting the chemical analysis of a water, one of the subjects "in addition," was first introduced into Colonel Bolton's monthly sheets in December, 1873. A special column, "Analysis of the Water," was then commenced, and was continued till December, 1874, when it ceased, and has not been revived. In the sheet for December, 1873, the analysis of the Kent, the New River, the East London, and the West Middlesex, were made by Dr. Letheby; that of the Lambeth was made by J. K. Bamber; while there was none made for the Southwark and Vauxhall, the Grand Junction, and the Chelsea. They are made "for the company." No reference was made in any way to explain why they were introduced, whether the companies thought that they thus showed how good their water was, or whether it was simply as a means of comparing results given in the returns to the Registrar-General is not explained.

The facts, taken as they stand, however, are as follows:—The waters of the companies had been analysed monthly, regularly for fourteen years, for the Registrar-General, when the "water examiner's" monthly sheets were commenced. Nothing on analysis was given in then, till the column referred to, "analysis of the water" made for the companies, was introduced. When this was given up in December, 1873, information respecting analysis was given on the back of the sheet; but it was something more than a mere change of position. The change began in the January sheet, 1875. The Water Examiner* then, for the first time, introduced a copy of the report made to the Registrar-General by Prof. Frankland. There is no title for the office held successively by Dr. Thomson, Prof. Hofmann, and Prof. Frankland, such as "Water Analyst." It would be convenient to have such a term, for though freedom from error in an analysis is not secured by its being "official," much stress is often laid in the controversies on London water supply, on the distinction between "official" reports and those made "for the companies." Prof. Frankland's first report in the sheet for May, 1874, on the Lambeth Company's water, is stated to have been made "for the company."† A question was raised in Parliament last Session as to whether certain monthly reports with an official looking title were official or not, and the reply was, that they were not. For want of some official title, such as "The Water Analyst," it often takes two or three lines of explanation to ensure accuracy of description in quoting reports. Colonel Bolton has endeavoured, in his monthly table, to give such information respecting the water as is likely to be of use, and, if there is no direct authority for printing reports of the analyses made "for the companies," it is in accordance with the spirit of Clause 36 of the Act of 1871, which provides that "the company may, if they think fit, on each occasion of such examination, be represented thereat by some officer, but such officer shall not interfere in the examination." There is a want of distinctness as to what is published by authority and what is not. The Acts, which are the sources of authority, are vague; the practice based on these Acts is variable. It is evident, that if the bare wording of the Acts only had been complied with, there

* In the margins of the appendices of the Local Government Board reports, the short titles given are: "Colonel Bolton's report," "Prof. Frankland's report," but they are indexed under their full title.

† Prof. Frankland states that he never analysed any water from the Lambeth Company, and that the figures given in Colonel Bolton's report of the water of this company, are the same as those of the analyses made officially for the Registrar-General in May, 1874; and published in the *Weekly Return*, for the week ending May 30, 1874.

would have been much less information available respecting London water supply than there is at present. On the other hand, for cases where it is important to distinguish between an official and unofficial report, it is difficult, if not impossible, to pick out what is included in a report, because it is useful, and what is included, because it is required to be there. For example, the report on the water supplied to Birmingham, and the water supplied to Glasgow, is sent in each month by Prof. Frankland to the Local Government Board. His own report of the analysis of the waters of the London companies is the official and only official report; but it is by no means clear how the reports for Birmingham and Glasgow stand.

This account of Colonel Bolton's series of reports does not attempt to decide what is official and what is not.

The change introduced in January, 1875, mentioned above, was accompanied by another change. By the side of the table, taken from analyses reported to the Registrar-General, in which the results are given in parts per 100,000, is a table in which the same facts are given expressed in "grains per gallon, for comparison with analyses furnished by water companies," and, under these, was given a table of the analyses made by Dr. Letheby on behalf of the companies. In February the same plan was followed, the only change of importance being that Prof. Frankland's analyses were addressed to the secretary of the Local Government Board, not to the Registrar-General. His table was on the same general plan as now, except that there was a column, "Previous Sewage or Animal Contamination, Estimated," which was discontinued after January, 1877. The three tables were continued in this way for nineteen months; but in September, 1876, Table No. 2 was discontinued, thus leaving the comparison of the parts per 100,000, and the grains per gallon of Table 3, to be worked out by those who cared to do so. Table 3 was continued by Dr. Letheby up to February, 1876. In March, 1876, and subsequently, this table was supplied by Dr. Meymott Tidy, but in June its title was changed to "Results of Analysis, made.....for the Society of Medical Officers of Health," and with this title, it was continued till December, 1879, when it disappeared. In the April of 1876, another change in form and another set of tables was introduced. In the column, "appearance of water," which was first spaced out for the daily observations in February, 1876, and which hitherto had been devoted only to statements about clearness, there was introduced tables of analyses made "for the companies." The first was by Dr. Whitmore, for the West Middlesex Company. In the June sheet, at the end of paragraph 12, is this sentence: "The analyses furnished by water companies are given in the within report, under the head 'appearance of water.'" The exigencies of finding room for further information in the already crowded sheet was no doubt the reason for utilising the spaces in between the lines giving the statements as to appearance. It, however, makes the column contain not only two classes of observations—one physical and the other chemical—but two sets differing in their origin, one official and the other not. The statements as to clearness are the official reports of "the water examiner." These statements, indeed, constitute the report as required by Section 36 of the Act of 1871, while the analyses "furnished by the companies" are optional. With this re-introduction of the analyses "as furnished by the companies," there were at this time three series of analyses given in the report. 1. That reported officially to the Local Government Board. 2. Those made by Dr. M. Tidy for the Society of Medical Officers of Health; and 3. Those made by different analysts for the different companies. Series 2 was discontinued after December, 1880. The printing of the dates on which the samples were collected were given up to the end of 1879. In a paper read before the Chemical Society in December, 1878, Dr. Tidy wrote—"I was most anxious that Dr. Frankland and myself should examine samples taken at the same time, so that our results might be strictly com-

parable, and that this could not be arranged was no fault of Dr. Frankland's or of my own, as he himself expressed to me his desire and willingness to make the necessary arrangements, which, however, were interfered with. . . ."

Though the dates on which samples had been taken never had coincided, they were given, and, as they were taken on one day in each month only, there was some rough guide. Coincident with the cessation of the dates, there was an entire change in the way of expressing the results obtained. Just before the cessation of Dr. Tidy's series there was introduced in the November sheet (the sheet for October) Messrs. Wanklyn and Cooper's series of reports.

Though, therefore, similar in appearance for so many years, the monthly sheets of the Water Examiner have varied much in the matter given "in addition to" the official report.

When Dr. Tidy's reports ceased those of Messrs. Wanklyn and Cooper took the second place, *i.e.*, immediately after Prof. Frankland's, and a totally new series was introduced in the third place, *v.z.*, the report by the Society of Public Analysts. The reports made the companies were the analyses of Drs. Tidy, Whitmore, or Bernays (the Grand Junction Company sometimes sending two reports). The reports of the Society of Public Analysts introduced a number of new names into the monthly sheet, but the report was given only in January and February, when the want of uniformity was severely criticised.

No further change took place till the introduction of the report by Messrs. Crookes, Odling, and Tidy.

(To be continued.)

CORRESPONDENCE.

RUBERINE.

To the Editor of the Chemical News.

SIR,—ON referring to p. 100 of the Chemical Society's *Journal* for January, it will be found that the new colouring-matter ruberine, extracted from *Agaricus ruber*, is stated to be *insoluble* in water and in alcohol, whereas in my original note, published in the CHEMICAL NEWS, vol. xlv., p. 199, I state that it is *soluble* in water and alcohol. In the "abstract," published by the Chemical Society's *Journal*, it is also stated that the solutions of ruberine are red by *reflection* and blue by *transmission*; whereas on reference to my original note in the CHEMICAL NEWS you will see it is *just the reverse*, the solutions being red by transmission and blue by reflected light.

Allow me to add that the American and Continental journals, which have reproduced my note from the pages of the CHEMICAL NEWS, have not fallen into such errors. Nor is this the first time that my attention has been called to similarly inaccurate "abstracts." I think it is the duty of any author to note inaccuracies of this description whenever he may observe them, as it saves a great deal of time and trouble to others, and points out the absolute necessity of referring to *original* papers in all matters relating to scientific observation.—I am, &c.,

T. L. PHIPSON.

London, January 7, 1883.

THE MANUFACTURE OF POTASH ALUM FROM FELSPAR.

To the Editor of the Chemical News.

SIR,—Amongst the notices from the *Journal of the Franklin Institute*, which you reproduce in the CHEMICAL NEWS, vol. xlvii., p. 5, is an article on "The Manufacture

* The conclusion of the sentence refers to official difficulties.

of Potash Alum from Felspar," by Mr. Henry Pemberton, Junr. In this the American writer gives a very fair summary of the difficulties to be overcome, and arrives at the conclusion that the cost of production will leave no margin of profit.

I am bound to say that with the accumulated experience which has come to my knowledge since reading the paper at the meeting of the Society of Chemical Industry, and hearing of the failure of the attempt to carry this process into practical operation at Conner's Quay, Flintshire, some years ago, by Mr. F. O. Ward, it does not appear that the process is likely to yield an advantageous result. The Messrs. Newlands stated in discussion at the meeting that they had proceeded much further than I did in preparing alum by this reaction on a large scale, but they did not think sufficiently well of it to warrant their risking a patent, finding, moreover, that Thomas Cobley had already a prior claim to the same idea (Specification No. 1734, July, 1861).

The "calcifluoric attack" of F. O. Ward may some day be practically utilised for the extraction of potash from granite and felspar, but it is clear, in view of these facts, that the time has not yet come for the successful development in England or America of the fundamental idea.—I am, &c.,

JOHN SPILLER.

London, January 9, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 2, 1882.

A Spectral Slit with a Symmetrical Movement of the Edges.—Dr. H. Kruss.—An improvement in the spectroscope for quantitative analytical purposes (German Patent, No. 7092). The arrangement cannot be intelligibly described without the three accompanying figures.

On the Certainty of the Method of Berthelot and Fleurien for Determining Tartar and Tararic Acid.—Dr. C. Amthor.—The authors show that the method in question is quite untrustworthy, at least as far as red wines are concerned, as notable quantities of sulphuric acid are precipitated by the mixture of ether and alcohol and estimated as tartrates.

Contributions to the Analysis of Wine.—Dr. J. Nessler and Dr. M. Barth.—The results of the authors' experiments are given in the form of tables, and do not admit of abstraction.

Alkalinity of Potassium Mono-chromate, and the Real Colouring-Matter of Litmus.—M. Richter.

New Volumetric Determination of Potassium Bichromate and its Use for the Titration of Caustic Alkalies.—M. Richter.—See page 19.

Separation of Small Quantities of Nickel in Presence of Cobalt.—Dr. A. Jorissen.—Already inserted.

A New Reagent for Nitrous Acid.—Dr. A. Jorissen.—Already inserted.

Detection of Cuprous Oxide in Presence of Cupric Oxide and of other Metallic Oxides.—Anton Orłowski.—The liquid under examination is acidified with hydrochloric acid, a small quantity of pure milk of sulphur is added, and the whole is heated to a boil. A change of the pale yellow colour to a black shows the presence of cuprous oxide. If it is desired to detect cuprous oxide in liquids which undergo a change on boiling

a piece of sulphur is thrown into the acidified liquid, and the whole is let stand for ten to twelve hours. In presence of much copper oxide the sulphur becomes blackened over its entire surface; if the quantity is small the sulphur turns brown on the sides only, or is covered with black spots.

Notes on the Determination of Phosphoric Acid.—Carl Mohr.—Already inserted.

Purification of Sulphuric Acid by Crystallisation.—R. S. Tjaden Moddermann.—The author finds that by repeated crystallisation a perfectly pure acid may be obtained from very impure samples containing lead sulphate, arsenious acid, and nitrogen compounds.

Reactions of Aloes.—Dr. W. Lenz.—An extensive memoir, chiefly of pharmaceutical interest.

Determination of the Foreign Elements contained in Wink-Copper.—R. Fresenius.—See page 18.

Determination of Potassium as Potassium-Platinochloride.—R. Fresenius.—This paper will appear at length.

Determination of Glycerin in Sweet Wines.—Dr. Eugen Borgmann.—10 c.c. of wine are evaporated to dryness in a porcelain capsule along with some quartz sand. The syrupy residue is gradually extracted with a measured volume of absolute alcohol (100 to 150 c.c., according to the quantity of sugar present), and the extracts are collected in a roomy glass flask. To 1 part of the alcohol there is now added 1½ parts of ether, the whole is well shaken up, and let stand at rest till entirely clear. The greater part of the sugar will be found collected at the bottom as a syrupy mass, whilst all the glycerin is held in solution in the alcohol-ether. The liquid is carefully decanted off, the sediment is washed with a small quantity of a mixture of 1 part alcohol to 1½ part ether. The liquid and washings are then distilled, the residue is rinsed with a little water into a porcelain capsule, and treated according to Neubauer's method for dry wines.

General Analytical Methods, Analytical Operations, Apparatus, and Reagents.—W. Fresenius.—Spectroscopic notes have been made public by C. A. Young. In many cases by the application of a sufficient dispersion, he has succeeded in resolving lines supposed to be common to several elements into several lines peculiar to each element. The theoretical conclusions drawn by Lockyer and others from the assumed coincidence of the lines are thus deprived of their foundation. Improvements in the spectroscope have been devised by H. C. Vogel and K. Zenger, and described in the *Zeitschrift für Instrumenten Kunde*. For weighing filters with precipitates C. Gilbert instead of watch-glasses uses a small hollow cone of nickelised copper foil. For determining the specific gravity of gases M. Th. Edelmann measures the pressure which columns of different gases of equal height exert upon a thin metallic membrane. Mercurial air-pumps have been devised by F. Neesen, E. Bessel-Hagen, and Alois Schuber, and are described in the *Annalen der Physik und Chem.*, vols. 11, 12, and 13. Capsules and funnels of papier-maché coated with a very resistant varnish are manufactured by R. W. Paulke, and are in many cases capable of being substituted for corresponding articles of glass, metal, or caoutchouc. The varnish resists undiluted sulphuric acid, strong alkalies, alcohol, ether, benzol, and carbon disulphide. A simple pipette for liquids which cannot be drawn up with the mouth has been devised by C. Mann. It consists of a moderately wide glass tube slightly contracted at one end, and its margin is expanded outwards at the other. This tube is thrust through the perforation of a cork in such a manner that the latter can slide up and down, though fitting air-tight to the tube. This cork is fixed air-tight in the lower end of a wider glass tube, which is either sealed above or closed with another cork. To use the pipette the wider tube is made to slide down as far as possible upon the narrower tube, the contracted end of the

latter is placed in the liquid, and the wider tube is then pushed upwards. This effects a rarefaction of the air within, and thus causes the liquid to ascend in the narrower tube. It can be expelled again by sliding the wider tube down. Caoutchouc tubes, according to Mareck, may be preserved from spoiling by keeping them under water when not in use. Caoutchouc stoppers which have become hard may have their pliability restored by digestion ten days at 40° to 50° in a 5 per cent solution of soda which is frequently renewed. They are then washed with water, scraped with a knife, washed again with warm water, and are fit for use. A new eudiometer has been proposed by J. Riban. Its construction cannot be intelligibly described without the illustration.

Chemical Analysis of Inorganic Bodies.—E. Hintz.

Qualitative Determination of Organic Bodies.—W. Fresenius.—Notices are given on the spectra of carbon and its compounds, by Messrs. G. D. Liveing, Dewar, Lockyer, A. S. Herschel, and W. M. Watts, as taken from the *Proceedings of the Royal Society, Nature, &c.*

Detection of Water in Alcohol and Ether.—C. Mann.—Already noticed.

Elementary Analysis of Organic Bodies.

Detection of Nitrogen.—O. Jacobsen.—From the *Berichte der Deutsch. Chem. Gesellschaft.*

Determination of the Carbon and Hydrogen in Nitrogenous Bodies.—W. H. Perkin.—From the *Journal of the Chemical Society.*

Determination of Nitrogen in Organic Matter.—S. W. Johnson and E. H. Jenkins.—This paper requires the accompanying illustration.

Analysis of Milk.—Notices of the methods of Hager for determining the total solids, the caseine, and the lactose; and that of C. Arnold for estimating the dry matter. D. Fuchs notices that pure milk never contains nitric acid, which is generally present in samples let down with water. Soxhlet defends his areometric process for the determination of the fatty matter against the criticism of Preusse. O. Dietzsch proposes a modification of the lacto-butyrometer. Heeren's "pioscope" serves to judge the quality of milk by the colour of a thin stratum, as seen through black glass. To distinguish boiled milk from fresh, C. Arnold adds tincture of guaiacum: fresh milk shows a persistent blue colour, whilst such as has been heated above 80° remains colourless. For the quantitative determination of dust in the air, W. Hesse aspirates a known volume through a small glass tube filled with cotton-wool.

Determination of Phosphoric Acid in Manurial Agents.—This extensive paper will be given at length at the earliest opportunity.

A Simplified Method of Determining Cellulose in Cattle Foods, &c.—This memoir requires the accompanying illustration.

Determination of the Value of Commercial Potassium Iodide.—O. Kaspar.—The author's method depends on the circumstance that 4 mols. potassium iodide are decomposed by 1 mol. mercuric chloride, so that along with potassium chloride there is formed a soluble double salt. If an excess of mercuric chloride is added this double salt is decomposed, and mercuric iodide is deposited, the commencement of which indicates the end of the reaction. To make the mercuric solution 2.71 grms. sublimate are dissolved in water, and made up to 100 c.c.; 1 c.c. of this solution indicates 0.06643 grm. potassium iodide. To effect the determination, a solution is prepared containing 10 grms. potassium iodide in 50 c.c., and 5 c.c. are used for each titration. The liquid is placed in a beaker, and the mercuric solution dropped in till a permanent reddish yellow colour appears. The mercuric solution should be freshly prepared for every series of experiments.

MISCELLANEOUS.

Royal Institution.—Professor W. C. Williamson will begin a course of five lectures on "The Primæval Ancestors of Existing Vegetation, and their Bearing on the Doctrine of Evolution," on Tuesday next, January 16. Professor Dewar will begin a course of nine lectures on "The Spectroscope and its Applications," on Thursday, January 18. Mr. R. Bosworth Smith, at the Friday evening meeting, January 19, will give a discourse on "The Early Life of Lord Lawrence in India"; and will begin a course of four lectures on "Episodes in the Life of Lord Lawrence," on Saturday, January 20.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 15.—London Institution, 5.
Medical, 8.30.

TUESDAY, 16th.—Royal Institution, 3. "Primæval Ancestors of Existing Vegetation," by Professor W. C. Williamson.
Institution of Civil Engineers, 8.
Pathological, 8.30.

WEDNESDAY, 17th.—Society of Arts, 8. "The Sanitary Inspection of Houses," by W. K. Burton,
Meteorological, 7. (Anniversary.)

THURSDAY, 18th.—Chemical, 8. "On a New Method of Estimating the Halogens in Volatile Organic Compounds," by R. P. Plimpton, Ph.D., and E. E. Graves.
London Institution, 7.
Royal, 4.30.
Philosophical Club, 6.30.

FRIDAY, 19th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.
Royal Institution, 9. "Early Life of Lord Lawrence in India," by Mr. R. Bosworth Smith.

SATURDAY, 20th.—Royal Institution, 3. "John Lawrence at Delhi and its Neighbourhood," by Mr. R. Bosworth Smith.

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Hour, THREE O'CLOCK.

Professor W. C. WILLIAMSON, F.R.S.—Five Lectures on the Primæval Ancestors of Existing Vegetation, and their Bearing upon the Doctrine of Evolution; on Tuesdays, Jan. 16, 23, 30, and Feb. 6, 13. *Half-a-Guinea.*

Professor DEWAR, F.R.S.—Nine Lectures on The Spectroscope and its Applications; on Thursdays, Jan. 18 to March 15. *One Guinea.*

R. BOSWORTH SMITH, Esq., M.A.—Four Lectures on Episodes in the Life of Lord Lawrence; on Saturdays, Jan. 20, 27, and Feb. 3, 10. *Half-a-Guinea.*

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First Friday Evening Meeting, 8 p.m. R. BOSWORTH SMITH, Esq., M.A., on The Early Life of Lord Lawrence in India, 9 p.m.

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THE CHEMICAL NEWS.

VOL. XLVII. No. 1208.

EXPERIMENTS, BY THE METHOD OF LORENZ, FOR THE FURTHER DETERMINATION OF THE ABSOLUTE VALUE OF THE BRITISH ASSOCIATION UNIT OF RESISTANCE, WITH AN APPENDIX ON THE DETERMINATION OF THE PITCH OF A STANDARD TUNING-FORK.*

By Lord RAYLEIGH, F.R.S.,
Professor of Experimental Physics in the University of Cambridge,
and Mrs. H. SIDGWICK.

THE experiments described in the present paper were carried out during the spring and summer months of the present year, at the Cavendish Laboratory, and are divided into three distinct series. In the first and second series the induction coils were situated nearly in the plane of the revolving disk, as in Lorentz's original use of the method; the difference between the two series relating only to the speed of rotation, which was varied in the proportion of 10:16. The third series presents a point of novelty, in that the induction-coils were separated from the disk to such a distance as to render the accuracy of the result practically independent of the mean radius of the coils.

The small resistance traversed by the battery current, to which the terminals of the galvanometer branch are connected, was obtained, indirectly, by a method of shunting. Thus, in the first series, the principal part of the battery current passed on one side through two unit coils, placed in multiple arc, and equivalent to $\frac{1}{2}$, and only a comparatively small remainder through a second branch, composed of two coils, of values 10 and $\frac{1}{10}$. The terminals of the galvanometer branch were connected with the extremities of the $\frac{1}{10}$, and the difference of potentials between them, due to the primary current, was thus reduced to that which would be required to drive the current through a resistance of $\frac{1}{20}$.

From the first series—

$$1 \text{ B.A. unit} = 0.98674 \times 10^9 \text{ C.G.S.}$$

From the second series—

$$1 \text{ B.A. unit} = 0.98669 \times 10^9 \text{ C.G.S.}$$

From the third series—

$$1 \text{ B.A. unit} = 0.98683 \times 10^9 \text{ C.G.S.}$$

As a mean we take—

$$1 \text{ B.A. unit} = 0.98677 \times 10^9 \text{ C.G.S.}$$

With use of the ratio between the mercury unit and the B.A. unit, found by us (*Proc. Roy. Soc.*, May, 1882) this gives—

$$1 \text{ mercury unit} = 0.94150 \times 10^9 \text{ C.G.S.},$$

or, which is the same thing, the ohm is the resistance of a column of mercury at 0° Cent., whose section is one square millimetre, and whose length is—

$$1062.14 \text{ millimetres.}$$

The very close accordance between the result of the present investigation and that obtained by the method of the revolving coil (0.98651), and by Glazebrook (0.98665) using another method again, leads us to hope that no error of importance can have escaped detection.

The Appendix is devoted to a record of experiments having for object the determination of the absolute pitch of a certain tuning-fork, which has served as the standard

of time throughout all our work upon this subject. It is believed that the method employed is worthy of attention, and may be useful to other physicists.

PRELIMINARY NOTICE OF THE ACTION OF DIBROM-NAPHTHOL UPON AMINES.

By RAPHAEL MELDOLA.

THE dibrom naphthol (m.p. 111°), obtained by brominating α naphthol, acts as a powerful oxidiser when heated with certain amines. Thus, when kept in a state of fusion for some time in the presence of diphenylamine, diphenylamine blue is formed in large quantity; and similarly the condensation-product of benzaldehyd and diphenylamine (diphenyl-diamido-triphenyl-methane) is instantly converted, by warming with this substance, into the diphenylamine green, described by me in a former paper under the name of "Viridine" (*Journ. Chem. Soc.*, May, 1882). When dibrom- α -naphthol is dissolved in aniline and the solution heated to 140° C. for about thirty minutes, a fine orange colour is developed, and on diluting with alcohol a basic substance, crystallising in large orange needles, separates out. Similar bases are obtained from para-toluidine and β -naphthylamine. These bases dissolve in hot dilute acids with a fine crimson colour, and form well characterised salts; the double salts with PtCl_4 , ZnCl_2 , &c., are bronzy crystalline products.

Other colour reactions of dibrom-naphthol and other haloid derivatives of phenols have been tried in the course of the present research. Thus dibrom-naphthol gives with α -naphthylamine and with cumidine, colours dissolving in alcohol with a magenta-like red; with resorcinol it gives a reddish brown. Monobrom- β -naphthol heated with α -naphthylamine gives a fine red. Tetrabrom- β -naphthol readily gives diphenylamine blue, and with β -naphthylamine a dull violet. Finally, tribrom-phenol oxidises diphenylamine into the well-known blue; with α -naphthylamine this compound gives a red, and with β -naphthylamine a violet.

The basic substances resulting from the action of dibrom- α -naphthol upon aniline, para-toluidine, β -naphthylamine, and other primary aromatic monamines, have for some months past been under investigation, and I hope shortly to be in a position to give more complete details as to their chemical structure. They appear to be produced by the replacement of both bromine atoms by substituted amido-groups.

In the mean time, I may state that an abstract of a patent by Leopold Casella and Co. (3rd addition to the German Patent, No. 15,915), for the preparation of blue and violet colouring-matters by the action of dibrom- α -naphthol upon para-diamines, which appears in No. 18 of the *Berichte*, just received, has determined the publication of this note in the present imperfect state of my investigations.

Atlas Works, Hackney Wick, E.,
January 11, 1883.

RESEARCHES ON THE GROWTH OF PLANTS UNDER SPECIAL CONDITIONS.

By A. B. GRIFFITHS, F.C.S.,
Member of the Liverpool Association of Science and Arts,
Medallist in Chemistry and Botany, &c.

HAVING heard of the remarkable properties of a certain patent chemical manure,* which has been known in the market for several years, in aiding the growth of plants,

* Abstract of a Paper read before the Royal Society, Jan. 11, 1883.

* Manufactured by Amies' Chemical Manure Company, London; and in use, I believe, in the Gardens of the Royal Botanical Society, and the Horticultural Society.

the author tried a few experiments a short time ago, to ascertain, if possible, the reason why plant life when treated with this particular manure should grow so luxuriantly as was evident from the condition of certain vegetables, fruits, and flowers belonging to some friends who used it. The manure is a dry black powder, and its chief ingredients are animal charcoal, phosphates, and ferrous sulphate. The details of the experiments are as follows:—

Three very young savoy cabbages, all nearly of the same weight, and in a healthy condition, were chosen. No. I. cabbage was planted on a piece of land, and no manure was added to the soil in which it grew. No. II. cabbage was planted on the same piece of land and near to No. I., but was treated with a weighed quantity of this chemical manure. No. III. cabbage was planted on a different piece of land to that on which Nos. I. and II. stood, and was treated like No. II. with the same quantity of manure, but grew more in the shade.

Plants Nos. I. and II. therefore received the same amount of sunlight and rainfall, but No. III. plant grew under different conditions. All the plants were placed in the ground on the same day, and grew from February to December. Then they were carefully taken up with their roots attached, all adhering soil was removed by washing, and they were then weighed.

Plant No. I., grown without the manure, weighed 4 lbs. 2½ ozs.

Plant No. II., grown with the aid of the manure, reached the great weight of 9 lbs. 3 ozs.

Plant No. III., also treated with the manure, but under different circumstances to those of No. II., weighed 8 lbs. 6 ozs.

These were grown in a garden in the vicinity of Lower Norwood, Surrey.

Now, various parts of the leaves and of the stem of each plant were separately reduced to ashes, the greatest care being taken in the incineration, to prevent the alkaline salts fusing, &c. The plants were burnt on a platinum sheet made in the shape of a muffle, and heated at a low temperature in a gas-furnace. These ashes gave the following results on being submitted to chemical analyses:—

	No. I.		No. II.		No. III.	
	Leaves.	Stalk.	Leaves.	Stalk.	Leaves.	Stalk.
Potash	33.951	41.231	31.634	39.223	31.521	38.929
Lime	15.665	13.601	14.210	13.583	14.310	13.621
Soda..	2.523	4.296	1.825	2.360	1.917	1.813
IRON (Fe ₂ O ₃)—						
	8.323	1.502	12.290	3.521	11.832	3.005
Magnesia	4.936	6.210	3.128	6.000	2.921	5.942
PHOSPHORIC ACID—						
	12.931	14.463	16.210	18.944	16.123	18.891
Sulphuric acid—						
	8.613	9.619	7.641	8.916	7.592	8.922
Chlorine—						
	7.994	6.781	7.310	4.200	7.400	4.319
Silica	4.999	2.294	5.631	3.121	6.265	4.468
	99.935	99.997	99.879	99.868	99.881	99.910

It will be seen from the above analyses that the plants treated with the manure contain a larger proportion of iron than those grown without the manure, and the leaves contain a larger percentage of iron than the stalks.

The conclusions to be drawn from these experiments are:—

1st.—The plants when grown in soil containing iron in a soluble form, and with phosphoric acid also in a soluble form, are healthier and larger than if they had been grown in a soil which did not contain these soluble compounds.

2nd.—The plants grown in soils containing this mineral manure appear to absorb larger quantities of soluble iron and soluble phosphates than when not so treated.

3rd.—The plant No. II., which was placed in the most favourable position as regards sunshine and rain, absorbed

a greater amount of soluble iron and soluble phosphoric acid than plant No. III., which was grown in a less favourable position. Whether the plants have the power of selecting and taking up by their rootlets these compounds from the manured soil, or whether the plants simply absorb any substance in solution supplied to them, I am unable to say; but it appears that the healthy condition and gigantic growth of the plants Nos. II. and III. were due to the fact that they were supplied with iron (in a soluble form, FeSO₄) and phosphoric acid also in a soluble form.

I am inclined to think that a fairly large proportion of soluble iron and soluble phosphates in a soil is favourable to the growth of plants of a deep green colour (that is, plants which develop a large amount of chlorophyll cells), like the varieties of cabbage.

From the researches conducted by Mr. F. C. Phillips, of the United States, "On the Absorption of Metallic Oxides by Plants" (CHEMICAL NEWS, vol. xlv., p. 224), it seems that his experiments confirm the non-discriminating theory of plant absorption of Dr. Freytag.

PYROLOGICAL NOTES.

By Lieut.-Colonel W. A. ROSS, late R.A.

(Continued from p. 4.)

IX. BORIC ACID AND ALUMINIUM PLATE (Continued).

A. The Inner Balls or Sphericles of Calcium Borate.

IT is a well-known fact now to most English, German, and American Chemists, not behind the progress of the day, that calcium pyroborate consists of 25 parts of caustic lime, and 75 of pure boric acid; or that, in other words, if you apply a weighed quantity of freshly-calcined lime to pure boric acid at blowpipe temperature, you will obtain a product—an insoluble transparent mass (fused boric acid itself being *extremely* soluble in boiling water) hard enough to scratch glass—exactly four times the weight of the caustic lime used to make it. This fact alone, the importance of which will be seen presently, ought, at last, to convince our chemists that these methods of blowpipe analysis are based upon sound chemistry, whilst the indefinite borax, or S.Ph. crystallisations are as evidently not, and lead to nothing but wasted time and talents in their examination, with the inevitable "vexation of spirit" accompanying such a loss. Twelve others of the "elementary" oxides thus form balls or sphericles when applied to boric acid B.B., which products are as evidently borates of those metals as calcium borate is of calcium, whilst some (as that of nickel), which form only fragments in this way, are obviously borates too, for, under adequate microscopical power, they are seen to consist of *definite* crystals.

It is not, however, with regard to this matter that I wish now to ask the attention of your chemist readers and your own, but to one comparatively new, which, for me, at least, possesses the most intense interest. About two years ago, by the advice of Dr. Edmunds, of Grafton Street, I invested in a first-class microscope for the purpose of examining the contents of these boric beads, and naturally, first submitted to the revealing powers of my new friend, a bead containing *wollastonite* borates, which had long puzzled me, using only a lens, on account of the curious "crystalline marks" covering the calcium borate balls; evidently due to the silica contained in that mineral. A ¼-inch objective at once showed me that these "marks" were transparent *inner balls*, due in some way or other to the silica of this calcium silicate (*wollastonite*); and it seemed to me, therefore, that, as to composition, the inner balls must be either silico-borate of calcium, or single borates, *i.e.*, silicon borate; which latter compound seemed

* "Alphabetical Manual of Blowpipe Analysis," page 118.

a chemical paradox. As the containing calcium borate ball is utterly insoluble in boiling water, and I at present know no menstruum* which will dissolve the outer, and leave entire the inner balls, so as to enable me to examine them *per se*, I was compelled to employ a process of mental ratiocination, instead of a process of physical analysis, to effect my object. I argued thus: "If these inner balls are silico-borate of calcium, balls will be formed when pure silica is applied to the calcium borate, held *by itself*, on a platinum wire without the containing bead of boric acid before the blowpipe: if, on the contrary, fresh boric acid derived from the outer containing bead is absolutely necessary for their formation, the presumption must be that the calcium borate will not give up any part of its proportion of boric acid to make the inner balls, so that that component must be *passed on*, as it were, from the outer containing *bead*, through the calcium borate *ball*, to the silica inside, and thus form *inner* balls of silicon borate." I trust I have expressed myself clearly in this account, and that the inference I have drawn from what happened is, in the opinion of your readers, a just one. If not, I would respectfully ask from yourself or your readers, the suggestion of another alternative.

However paradoxical it may appear, the latter was the alternative afforded me by the practical experiment. Pure silica dissolved rapidly, transparently, and completely in calcium borate before the blowpipe, affording no balls; but, on crushing this siliceous calcium borate, and applying some of the powder to a fresh bead of boric acid B.B., balls were formed in the bead perfectly crowded with *inner* balls. Another extremely interesting fact was ascertained with regard to the *change of weight* of these siliceous calcium borate balls, which I must leave to be considered in another paper.

B. Black Sublimates from Volatile Metals on Aluminium Plate.

I believe I was the first to discover (in 1871) the curious fact that volatile metals evolve a *black* sublimate when treated before a blowpipe (in addition to their other sublimates), which has been lost to pyrological chemists, on account of their use of black charcoal as a support. This black sublimate invariably occupies the lowest position on the vertical aluminium, surrounding the assay itself, and, as can easily be proved by means of boric acid, and in other ways, is in a state of lower oxidation than any other sublimate.

Surely, it is a most extraordinary, and extraordinarily interesting fact, that these "semi-metals" of the old chemists and alchemists, should *invariably*—however different the colour and form of their other sublimates may be—afford this black suboxide or body-sublimate when thus treated? It is a *constant* product in the sublimation of *all* these metals, each black part being almost or exactly similar to the other black part, until changed by pyrooxidation or other means; and therefore would seem to be a constant factor or constituent in all of them. No doubt all metallic sublimates can now be very much more easily, and, therefore, closely, examined than the old sublimates, scraped from what was left of them after blowpipe treatment on charcoal, could possibly have been. For instance, the late Professor Plattner very naturally considered, as the white sublimate from lead was produced by the blowpipe *on charcoal*, and as the known chemical oxides of lead (also produced by the blowpipe), are differently coloured,—yellow, red, brown, &c.,—whilst the known chemical carbonate of lead is white, that the white sublimate evolved from pure lead on charcoal by the blowpipe is "carbonate of lead"; but if he had used aluminium plate and boric acid in his examination of this matter, he would have found (a) that the white sublimate from pure lead, carefully scraped off aluminium plate, dissolves transparently and without effervescence, in boric acid before the blowpipe; and (b) that an indubitable

carbonate of lead (such as *cerussite*) when similarly treated, immediately renders the bead milk-white and opaque, much effervescence (carbon dioxide) being at the same time produced.

(To be continued.)

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING DECEMBER 31ST, 1882.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To the RIGHT HONOURABLE THE PRESIDENT OF THE
LOCAL GOVERNMENT BOARD.

January 1st, 1883.

SIR,—We submit herewith the results of our analyses of the 161 samples of water collected by us during the month of December, on the days and at the times indicated, from the mains of the seven London water companies taking their supply from the Thames and the Lea.

Of these 161 samples, the whole, without a single exception, were found to be bright, clear, and efficiently filtered.

In Table I. we have recorded the analyses in detail of a daily sample, taken from December 1st to December 30th inclusive. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XLV. to XVIII.

We have recorded in Table II. the tint of the several samples of water as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples collected.

It will be seen that in respect of aëration, colour, and freedom from turbidity, the condition of the water during the past month has been unexceptionable; while the proportion of organic matter has fallen somewhat below that usually met with at this period of the year.

In our own previous monthly report we drew attention to the circumstance that, concurrently with the setting in of the winter season, there was, as there customarily is, a notable increase in the proportion of organic matter present in the water supply. In the report for the same period made to the Registrar-General, attention was also called to this increase; and further, the water distributed by four out of five of the Companies taking their supply from the Thames, was pronounced *ex cathedra* to be "unfit for drinking" by reason of its "organic impurity." Now we take upon ourselves to assert that the analytical results set forth in the report, which are not appreciably different from our own, do not afford ground for any such appalling statement; and that the million or more consumers of the water furnished by these stigmatised companies, have not had their health in any way jeopardised by their consumption of the water supplied to them; and that they have not been placed, during the month of November, in any respect in a different position, as regards injury to health, consequent on the character of their drinking-water—admittedly unobjectionable in taste and appearance—from that in which they were placed during the summer months; when, owing to the different conditions of river life and change, the proportion of organic matter in the water was about one-third or one-fourth of its recent amount,—the maximum of which found in any sample, as recorded in the report to

* Prof. G. G. Stokes recommends me to try acetic acid.

the Registrar-General, was under three-quarters of a grain per gallon, or amounted to about the one-thousandth part of one per cent of the reprobated water.

As bearing on this question, we would recall to mind that the last Royal Commission on Water Supply, after hearing very varied scientific evidence, much of it of the usual alarmist character, reported to the effect that the presence of a small quantity of organic matter in drinking water was not necessarily prejudicial, and that there was not any evidence to satisfy them that the particular organic matter present in filtered Thames water was prejudicial.

We have the honour to remain, Sir,
Your obedient Servants,

WILLIAM CROOKES,
WILLIAM ODLING,
C. MEYMOTT TIDY.

CHEMICAL ANALYSIS OF INORGANIC BODIES.

By E. HINTZ.

A. CLASSEN and M. A. von Reiss propose for the separation of metals, the electrolysis of the double compounds of the oxalates and ammonium oxalate. Simultaneously and independently, H. Reinhardt and R. Ihle propose to determine zinc by the electrolysis of the potassium double oxalate. (For a description of the processes of Classen and Von Reiss see CHEMICAL NEWS, vol. xlv., p. 105.)

Reinhardt and Ihle prefer to separate zinc from the potassium double salt, because, according to their experiments, this metal is apt to deposit in a pulverulent form if ammonia or nitrates are present. The determination is not interfered with by the presence of free oxalic acid, though the precipitation is rendered slow. A current which yields 90 c.c. detonating gas hourly is sufficient for the complete precipitation of zinc. On account of the ease with which precipitated zinc is oxidised, the authors recommend that it should be dried in the exsiccator.

For the determination of cadmium E. F. Smith recommends the electrolysis of the neutral acetate. Cadmium can also be perfectly separated from a hydrochloric, nitric, or sulphuric solution after supersaturation with sodium acetate. In opposition to the statement of Wrightson, that the sulphate is not well suited for the electrolytic determination of cadmium, he has obtained satisfactory results with the neutral sulphate, and even in presence of free sulphuric acid.

The circumstance that cadmium is not precipitated by the current from solutions containing free nitric acid has been applied by Smith for the separation of cadmium from copper. After precipitating the copper he draws off the liquid, concentrates, adds excess of potassa and potassium cyanide, and submits to electrolysis.

For the determination of uranium and its separation from the alkalies and alkaline earths, E. F. Smith proposes the following method:—

The solution of the acetates, slightly acidified, is introduced into a platinum capsule, which serves as positive electrode. If the capsule is heated in the water-bath and submitted to the current of two chromic acid elements, yellow uranium hydroxide is first deposited on the sides of the capsule, which gradually becomes black, passing into urano-uranic hydroxide. When this change has taken place no more uranium can be found in the solution. The liquid is decanted out through a small filter, and the capsule is washed with hot water. To determine the precipitate the filter is replaced in the platinum vessel, dried, incinerated, ignited, and weighed as uranoso-uranic oxide.

E. F. Smith has extended his experiments to molybdenum. From an ammoniacal solution of molybdic acid the molybdenum may be completely thrown down electrolytically as hydrated sesquioxide, but the precipitation

requires so much time that the method cannot be recommended.

Smith's method of separating barium from strontium, calcium, and magnesium was to precipitate the barium from a neutral solution with neutral potassium chromate. Frerichs modifies this process by precipitating the barium in an acetic solution. Morse considers the precipitation in an acetic solution as approximately complete, but the washing with dilute acetic acid he finds inadmissible unless some barium chromate is added, when the quantity of barium chromate dissolved is vanishingly small.

For the separation of iron from manganese, zinc, cobalt, and nickel, J. Jewett mixes the cold concentrated acid solution with sodium carbonate until a slight precipitate is formed, which is not re-dissolved on shaking. This precipitate is dissolved in hydrochloric acid added by drops, carefully avoiding excess. He adds a certain quantity of acetic acid, to be found in a table which he appends, and sodium acetate, and boils for a minute or two minutes, after diluting the solution to about 300 c.c. The precipitate is then washed with boiling water containing 2 grms. per litre sodium acetate and 1 c.c. acetic acid till the chlorine reaction disappears. If the proportion of acetic acid exceeds 5 per cent, iron remains in solution.

For the separation and volumetric determination of lead, Haswell proposes a method based on the following reaction:—If a moderately dilute solution of lead nitrate is mixed with a few drops of very dilute pure potassa, gently heated, and a solution of potassium permanganate added, the latter liquid is decolourised with formation of a deep brown precipitate, so long as the solution contains lead. The process is executed as follows:—The solution containing the lead as nitrate, and which may be neutral or slightly acid, is mixed with zinc oxide suspended in water, and a solution of permanganate of known strength is dropped in, in the cold, with constant agitation, until the liquid floating above the precipitate has a faint pink tint. On applying heat, this colour disappears. The reaction cannot be considered complete until the faint pink colour produced on adding another drop of permanganate does not disappear on boiling for a minute. Alkalies, alkaline earths, and salts of alumina, chrome, zinc, and iron (ferric), do not interfere. The method is not admissible in the presence of salts of manganese, cobalt, nickel, iron (ferrous), bismuth, and copper. Traces of silver are not injurious.

Hydrobromic acid is recommended by Endemann and Prochazka as a sensitive reagent for copper. A solution of copper bromide on evaporation, or treatment with dehydrating agents, appears, first, deep red-brown, and then black. If the cupreous liquid to be tested is mixed with an excess of concentrated hydrobromic acid, the change of colour begins at once. According to the author 1-100th m.grm. copper occasions a rose colouration. The presence of great quantities of iron interferes with the reaction.

The process of Schneider and Fyfe for the separation and determination of arsenic as modified by Emil Fischer has been already noticed.

M. Richter proposes to determine chromic acid when occurring in neutral alkaline chromates, volumetrically, by precipitating completely with a solution of silver nitrate of known strength, and determining the excess of silver nitrate with sodium chloride.

For the detection of chloro-chromic acid, H. W. Wiley places a drop of sulphuric acid in a porcelain capsule, adds a little strychnine, and stirs with a glass rod, which has been previously moistened with a liquid containing chloro-chromic acid. The well-known violet-blue colouration appears which characterises strychnine when its sulphuric solution is treated with an oxidising agent.—*Zeitschrift für Analytische Chemie*.

Appointment.—Mr. F. J. M. Page, B.Sc., F.C.S., of University College, London, was elected, on January 11, Lecturer on Physics at the London Hospital Medical College.

USE OF CÆRULEINE IN WOOL-DYEING.

By AMAURY DE MONTLAUR.

WHEN M. Durand made his interesting communication to the Society of Mulhouse this dye was too costly to be of practical importance. Its price has now been reduced to 3½ francs per kilo., and a kilo. of wool may now be dyed for 1 franc, which is not more than the general cost of fast colours. Contrary to what has been said, the only good method of applying this colour is by reduction and subsequent oxidation.

For wool-dyeing the colour is stirred up in a pail with an equal weight of sodium bisulphite (sp. gr. 1·39); zinc powder is added to the extent of one-tenth of the weight of the cœruleine. The whole is intimately mixed, the pail is covered up, and let stand for two hours. It is then added to the dye-pan and the temperature is raised.

The wool should be mordanted with alum or sulphate of alumina and cream of tartar, as for madder. In this manner good greens are obtained with perhaps a slight olive cast, but soaping at a hand-heat brightens the shade.

Chrome mordants are much superior for the intensity and fineness of the shade. I have remarked that many dyers do not neutralise their alums. Alum is sometimes used which requires 8 per cent of its weight of soda crystals for neutralisation. Hence the formation of insoluble salts becomes very problematical, and to fix the mordant in the fibre violent and prolonged boiling is required, which weakens the wool, felts it, and occasions waste, in addition to yielding tissues of a less silky handle. This procedure renders the dyeing more tedious, and the prolonged boiling in the case of cœruleine re-oxidises the bath and necessitates the addition of bisulphite, a fresh cause of expense and of uncertainty as to the reducing value of the bath,—a very important point in cloth-dyeing. The wool is introduced into the bath, which ought to have a brown colour, slightly yellowish, and is well worked. If the bath is green, and if the wool takes a green tint in the bath, more bisulphite must be added mixed with the tenth part of its weight of zinc powder. The wool is kept at a gentle boil, and it is well to cover the pan with boards to exclude air as much as possible. The dyeing is carried on till a bit of the wool, well drained and exposed to the air for ten minutes, takes the required shade. The wool is then taken out, well drained as it issues from the liquid, and spread out in a thin layer to promote oxidation. It is turned over several times at intervals of some hours, so that every part may be equally exposed to the air. At the end of twelve to fifteen hours it may be washed, but it is better to allow it first to dry.

Cloth-Dyeing.—For very compact goods, such as army cloths, cœruleine is not to be recommended. Light goods are easily dyed, but a much larger quantity of the reduced dye is needed than for wool. The cloth when taken out of the dye-pan should be drained rapidly and completely, otherwise there is danger of spots, especially if an excess of bisulphite has been employed.—*Moniteur Scientifique.*

Methods relating to Forensic Chemistry.—W. Lenz. —A. G. Pouchet proposes to effect the destruction of organic matter prior to the search for mineral poisons by treatment with 25 per cent pure potassium bisulphate and the same weight of fuming nitric acid. Selmi makes up the matter to a paste with sulphuric acid, and treats it with a current of hydrochloric gas at 130°; the gas passes out through a receiver heated to 130°, and is then received in water. F. Selmi finds in the urine of persons poisoned with arsenic, not merely arsenious acid, but also arseniferous bases. Hager notes that Schneider's method for the separation of arsenic by distillation as chloride can be effected even if the arsenic is present in the state of arsenic acid. E. Reichhardt gives a modification of Lassaigne's process, which cannot be reproduced without the accompanying figure.—*Zeitsch. f. Anal. Chem.*

REPORTS ON THE EXAMINATION OF THAMES WATER.*

(Concluded from p. 23).

Registrar-General's Report.

IN the weekly return of the Registrar-General for October, 1857, p. 334, there is given an analysis of the water of the Southwark Company, by Dr. Robert Dundas Thomson, of St. Thomas's Hospital. This appears to be the first time that water analysis found a place in these publications. Dr. Thomson, in November, first supplied the analyses of the waters of the various companies, and his reports for November and December are given in the first number (for January), 1858; from that time he continued to furnish monthly reports till June, 1864. It would be interesting to know the history of thought on the subject of water in connection with health, at the period of 1850 to 1860. In the "Notes on Previous Enquiries," there was brought together as much as could be found of printed opinions, and of records of the investigations made to estimate the truth of the supposition that disease might be spread by water; a supposition arising with, or at least brought forward by, Dr. Snow. But beyond these records, except, perhaps, in the daily press, there is no indication that the subject did receive much thought. The inquiry into the 1849 outbreak of cholera probably drew attention first to the subject, and in the writings of Simon and Farr will be found probably all that is of lasting value. But the inquiries were of a purely statistical character, the chemical examination of the water was not included. That whatever had any influence at all in connection with disease was an idea pronounced, in eloquent language, as preposterous, and was evidently only timidly and cautiously admitted by those that did admit it. The inquiries of 1851 and 1856, however, were specially directed to chemical subjects, and instructions as to the points on which information was wished were issued. By 1857, the chemical analysis of a company's water found a place, as mentioned in the Registrar-General's Report. From 1858, "monthly analyses," that is, monthly returns, stating the results of analyses of water, taken one day in each month from a company's supply, have been issued, except for the months from July, 1864, to January, 1865. Dr. Thomson supplied them gratuitously at first, but after January, 1862, the Treasury allowed a small annual payment for them. They may be regarded, therefore, as official from this date. The gap from July, 1864, to February, 1865, was caused by Dr. Thomson's death.

The analyses for February, March, April, and May, 1865, were made by Prof. Hofmann, and that of June by Prof. Frankland, who has regularly furnished the monthly analyses since. The place in which this series of monthly reports is issued is the "Weekly Returns of Births and Deaths in London." The report for a month is generally given in the number for the second or third week of the succeeding month. It has sometimes been later, and as there is no index, there is no other course for those who wish to consult a series in any period, than to look through the weekly returns. In almost all cases, in addition to the mere table of figures, there is a more or less extended report, whilst occasionally, as during the prevalence of a cholera epidemic, special and elaborate reports have been given (see Registrar-General's Weekly Returns for 1866, p. 451); but to these, again, there is no index.

In the 1866 Rep., supp., p. 257, app., is a summary and comparison of 1850, 1856, and 1866.

Besides the weekly returns, there is an annual publication of the Registrar-General, in which, since 1867, Prof. Frankland has made a formal "Report on the Analysis of the Waters."† The first was a report of three pages, with

* From the *Journal of the Society of Arts.*

† The Annual Reports of Professor Frankland were not brought under notice in the article printed in the *Journal of the Society of Arts* of September 8. The monthly reports only are mentioned at p. 673.

five pages of tables. (In the previous year there was a letter of half a page). This annual publication is quite distinct from the annual report of the Registrar-General. It is a summary of the weekly returns during the year; it was not, however, called a summary on its title-page, till 1866, and it was not until 1870 that the title-page bore "Annual Summary." It is now commonly quoted as the annual summary of the Registrar-General. In everything but the title, however, it is practically the same sort of publication as it was in 1860, when the title was "Weekly Tables of Births, Deaths, and Causes of Death, in London, during the year." To those not acquainted with these changes, there might appear to be two distinct series.

The Object of the Tables.

The explanation of what the tables given in the reports mean, and what is supposed to be the value of the determinations, must be sought principally in papers read before the Chemical Society. The most important of these papers are:—Prof. W. A. Miller, in vol. xviii., 1865; Prof. Frankland, in vol. xix., 1866; Prof. Wanklyn with Messrs. Chapman and Smith; and another by Prof. Wanklyn, in vol. xx., 1867. Then in the next year, 1868, vol. xxi., four papers, by Prof. Frankland and Mr. Armstrong, by Prof. Frankland, by Prof. Wanklyn and Messrs. Chapman and Smith; by Mr. Chapman;* in vol. xxix., 1876, by Prof. Frankland; in volume for 1878, by Dr. Mills; in volume for 1879, Dr. M. Tidy; in volume for 1880, Miss Halcrow and Prof. Frankland, and a second paper by Prof. Frankland alone.

Prof. Miller, in his paper, pointed out that "there is much less agreement between different operators in the exact modes of conducting the details of the analysis than might have been expected." This was in 1865, after the Registrar-General's reports had been given for eight years. The paper is an important one, as it was written "with the hope of contributing something towards facilitating greater uniformity in practice, and of adding precision to the results obtained," and the methods referred to were selected "from every available source." The subjects referred to, include:—(1) The use of the two-foot tube for testing clearness; (2) the arbitrary scale of colour; (3) amount of sediment; (4) taste; (5) odour; (6) hardness; (7) the determination of the amount of organic matter, "as it is often loosely termed," by evaporation and incineration; (8) the use of potassic permanganate (to which four pages is given); (9) the gaseous constituents; (10) estimation of ammonia; (11) estimation of nitrites; (12) estimation of nitrates.

Prof. Frankland's paper, in 1866, gives an explanation of the methods employed by him in the analysis of metropolitan waters. The details of the process for determining by potassic permanganate, the amount of oxygen required to oxidise the organic matter present are given, and the paper is accompanied by five charts, which show the monthly fluctuations. Messrs. Wanklyn, Chapman, and Smith (1867), after stating that the processes employed in water analysis had never been properly investigated, criticise the value of the processes and propose the ammonia process.

The paper by Prof. Wanklyn alone is in verification of the previous paper. Prof. Frankland and Mr. Armstrong (1868), drew attention to the "formidable difficulties" which surround water analysis, and give the results of two years' work on the value of the following determinations:—1. The estimation of total solid constituents. [The omission of sodic carbonate is recommended]. 2. The estimation of organic and other volatile matter. [The difficulty of determining the meaning of loss on ignition is mentioned]. 3. Determination of the amount of oxygen necessary to oxidise the organic matter. [The untrustworthiness of the permanganate process is particularly mentioned]. 4. Estimation of nitrous and nitric acids. 5. Estimation of ammonia. The processes proposed as

substitutes are then given. Messrs. Wanklyn, Chapman, and Smith, in their paper, deal critically with this paper, and write in vindication of their process. The paper by Dr. Tidy (1879) includes a description of a new process, which he calls the oxygen process, and in this the real value of the permanganate test is entered into at considerable length. The uncertainty of a colour test, owing to the fact that so many people suffer from partial colour-blindness, is specially dwelt upon.

The ignition process, the combustion process, and the ammonia process, are all considered critically.

The examination of the waters of the London Companies, by Messrs. Crookes, Odling, and Tidy, is made in accordance with the views expressed in this paper. They give four examinations a month of each of the companies, and, in the spring of 1882, issued a set of coloured charts, summarising the results of March (including part of February) to December, 1881.

It will be noticed in the reports that all analysts, in addition to their results, give expression to opinions which involve physiological and pathological considerations.

NOTICES OF BOOKS.

The Electric Lighting Act, 1882. By CLEMENT HIGGINS, M.A., F.C.S., Recorder of Birkenhead, and E. W. W. EDWARDS, B.A., Barrister-at-Law. London: W. Clowes and Sons. (Lim).

WHATEVER may be the future of electric lighting, now that such vast sums of money have been embarked in this new scientific industry it is at least necessary that those Local Authorities, Companies, and others interested in this mode of lighting should make themselves acquainted with the legal points of the subject as they stand at present.

This small work before us has been drawn up as a legal guide for the assistance of those concerned in the installation of electricity for industrial purposes, and contains "The Electric Lighting Act, 1882," "An Act to facilitate and regulate the supply of electricity for lighting and other purposes in Great Britain and Ireland," "the Board of Trade rules, the Incorporated Acts, and cases decided thereon, together with such explanatory notes as have occurred to the authors after a careful study of the legal and technical aspects of the subject." The numerous legal and scientific notes that occur throughout the text will be found of much service in comprehending the technical points of the Act. For instance, regarding the safety of the public from personal injury, or from fire, or otherwise, we have the report of the Committee appointed by the Council of the Society of Telegraph Engineers and Electricians, with the rules and regulations they recommended for securing safety from dynamos and lamps, and the points to be attended to in the wires and connections.

As to the limitation of the prices to be charged for the supply of electricity, we have in a lengthy note the evidence and reports of some of the best authorities on the matter of cost of installation and working for different areas. Practical electricians, however, will require more extended experience than they at present possess on this subject before definite ideas can be arrived at for fixing the cost to consumers.

Under Section 23 of this Act, which states that "any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses any electricity shall be guilty of simple larceny and punishable accordingly," the authors give in a note extending over several pages a pretty clear explanation of the terms electromotive force, resistance, quantity, &c., and the units adopted for the measurement of electricity, concluding with a short account of the electrolytic processes that have been suggested as meters to prevent dishonesty on the part of the consumers. As it is the book and not the

* Then, for eight years, there is no paper of importance.

wisdom of our legislators that we have here to deal with, we can only say that the arrangement of the work and the copiousness of the notes and references will render it an invaluable guide to the legal points of electric lighting as they are at present.

Technisch-Chemisches Jahrbuch, 1881-1882. (Year-Book of Technological Chemistry.) By Dr. RUD. BIEDERMANN. Berlin: Julius Springer.

IN these days of statistics and averages it might afford one no little amusement, not to mention the profitable information that might be acquired, by an investigation of the vast number of patents granted in a single year in any industrial country, and tracing out as far as possible the ratio of the practically successful to the unsuccessful ingenious contrivances of the inventive faculty of man. Judging by the contents of the small work before us, the task, however profitable it might be, would not be an easy or a small one.

Here we have in a compact and handy form a record of the progress of practical chemistry during twelve months as indicated by the patents granted for improvements, chiefly in the German Empire. This Year-Book, as the compiler tells us, forms an illustrated report of the improvements that have been made in technological chemistry during the period comprised between July 1st and the end of the following June, together with short notices of investigations of technological interest published in the scientific journals during the same period. The first few pages of the book contain metallurgical and other statistics relating to German industry. The greater portion of the remainder of the volume is divided into sections, each devoted to a special technological subject, as iron, zinc, sulphuric acid, glass, explosives, dyestuffs, &c., containing brief abstracts of the more important patents granted for improvements in these industries, a few statistics for the past year being appended to each.

A special chapter is given to improved forms of apparatus employed in the various branches of industrial chemistry, such as filter-presses, pulverisers, temperature regulators, galvanic batteries, and so forth. In the final chapter we have a very complete catalogue of the works on chemistry and physics recently published in England, Germany, and France.

Such a mass of information as is here collected together, and arranged in so small a compass, cannot fail to be of considerable utility to the technologist or inventor, affording as it does a survey of the most recent advances in practical chemistry made in Germany. The value of this work to the practical man is increased by the presence of 374 very neatly executed drawings of the machines and apparatus described in the text.

Technologisches Wörterbuch in englischer und deutscher Sprache. (Technological Dictionary in English and German.) By GUSTAV EGER. Brunswick: Frederick Vieweg and Son.

THE great impetus given to technology within the last thirty years by the introduction of scientific methods of precision into manufacturing processes, and the vast metallurgical and chemical industries that have sprung into existence, have rendered intimate commercial intercourse with our neighbours and competitors a matter of necessity. The demand thus created for such dictionaries as this has been the means of bringing forth compilations innumerable of commercial and technical phrases, of various degrees of quality and usefulness. The present addition to the stock professes to contain the terms and locutions employed in architecture, civil, military, and hydraulic; chemistry; mining and metallurgy; mineralogy; ship-building, &c., &c., and consists of two parts, English German and German-English.

The first part now before us is edited by G. Eger in connexion with the well-known English Chemists, Drs.

Bedson, Burghardt, Carnelly, Lunge, J. J. Hummel, and W. C. W. Williams, and has been technically revised and enlarged by O. Brandes.

From a careful examination of the contents of this work, especially the words relating to chemical science, we feel sure that it does not profess too much, and we have no doubt that it will be found a useful and reliable technological dictionary of the two languages.

The distinctness of the printing, so requisite in a book of this description, is all that could be desired, but for much handling a stronger binding than the present possesses would be absolutely necessary.

CORRESPONDENCE.

CHEMICAL NOMENCLATURE AND NOTATION.

To the Editor of the Chemical News.

SIR,—The last number of the *CHEMICAL NEWS* contains a reprint of the instructions, with reference to the above subject, issued by the Council of the Chemical Society. With many of these instructions I cordially concur, but from several of them I strongly dissent, for reasons which will be specified below.

As regards the name to be given to common salt, the Instructions recommend "*sodium chloride*," and go on to advise, as may be clearly inferred, that "*sodic*," or a general termination in *ic*, is objectionable. It nevertheless appears to me that names having the latter characteristic are much to be preferred.

In the first place, may I remind your readers that one of the most systematic nomenclatures ever constructed was the one devised by the father of an existing notation, viz., Berzelius? It was published by him in the *Journal de Physique*, in a Latinised form, and throughout it nouns are qualified by adjectives, the common termination of the latter being *icum* (*ic*). The nomenclature adopted in England was for many years a literal translation from the French: it abounded, as we all know, with such barbarisms as "*chloride of sodium*," which are not English at all, and have long been abandoned by every systematic writer. The process of abandonment was accelerated by the action of the Chemical Society, whose Council, many years since, placed the whole question in the hands of a Committee, consisting of Professors Miller, Williamson, Foster, and others. The Committee, fortunately as I think, were not unanimous, and as one important result of this, there was no recommendation as to uniformity. But one practical effect was the revival of the Berzelian nomenclature, and its regular adoption into our own tongue, by the chemists above named, by Professor Frankland, and many of their *confrères* and students; and I need not say that it continues to be extensively employed, and has never been objected to on any tangible grounds. The nomenclature in which noun is prefixed to noun, instead of adjective to noun, is of course much later than the Berzelian, and of late years has subsisted side by side with the English form of the latter. Its success I believe to have been mainly due to its resemblance to the set of names employed in German memoirs, but which our German friends have never dignified with the title of "*nomenclature*." Historically speaking, names of the "*sodium chloride*" type have no grammatical pedigree. In the second place, the authors of these terms have, as far as I am aware, adduced no reason for their introduction, excepting that the original designations of constituents are least altered by their plan. But if this reason had any real weight, why stop short at the first word and neglect to restore the second. On logical grounds they should call common salt not "*sodium chloride*" but "*sodium chlorine*."

Again, the ordinary grammatical usage of the English language is to qualify by means of an adjective. It is true

that, in common unsystematic parlance, we sometimes make use of such terms as "iron spoon," "copper plate." But these compound nouns furnish no support to the Instruction proposal. "Iron spoon" means "spoon made of iron;" no one supposes that by "sodium chloride" we are to understand "chloride made of sodium." Sometimes the heaping up of nouns leads to almost hopeless confusion. For example, "Take ten parts of hydropotassic sulphate" is intelligible enough; but "Take 10 parts of hydrogen and potassium sulphate" is—can anyone say what it is?

The habitual use of certain names is very apt to stereotype upon the mind the ideas connected with them. Now, chemical science has at present a notation admitted by many to be imperfect, and by some to be largely erroneous. Common salt, for instance, is still written NaCl ; and unhappily this is the best—or, rather, least unfortunate—formula we can at present adopt. But what does it obviously suggest to everyone who reads it? Not less than this—that common salt contains sodium and chlorine; and that chlorine and sodium have lost nothing by the act of combination. I hold both these suggestions to be equally unfounded, and am not alone in so doing; yet I cannot help, alas! tolerating the formula. When, however, it is proposed still further to emphasise these suggestions of the formula by embodying them in a name,—a name at least alleging the existence, as yet unproved, of sodium in the salt—then, I consider, we are at an infinite distance from the facts, and our procedure is open to questions of the very gravest character. Such names as "sulphur trioxide" are open to objections of a precisely similar nature.

The Instructions also present some other, though minor, difficulties. Why, for example,—as Williamson remarked long since,—should the term "anhydride" be retained, when the bodies to which it refers are, as frequently as not, obtained in other ways than by the removal of water? Why continue to use the word "equation," when, as everyone will agree, the *thing* referred to is merely an equality?

Lastly, may I venture to suggest that an act of uniformity for a learned Society is in itself undesirable. It is, indeed, in the case of a mobile science like our own, a practical impossibility. If proof of this were needed, it would be found in the fact that the Instructions reprinted in your issue of last week, are admittedly different from those originally (1879) decided on.

I have probably written enough to show that the unanimous assent of all chemists, whose opinion is entitled to be considered, has not been obtained, and is not likely to be obtained. I, therefore, express an earnest hope that the proposed scheme of uniformity may not be pressed. Much as I value and, indeed, esteem the greater part of the Instructions, I claim for myself and others an ample liberty to dissent from any of them.—I am, &c.,

AN OLD FELLOW OF THE CHEMICAL SOCIETY.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcv., No. 26, December 26, 1882.

Separation of Gallium.—Lecoq de Boisbaudran.—See page 16.

Electro-dynamic Method for the Determination of the Ohm. Experimental Measurement of the Constant of a Long Coil.—G. Lippmann.—This paper does not admit of useful abstraction.]

Chemical Studies on Maize at Different Stages of its Growth.—H. Leplay.—A continuation from the last number.

Instantaneous Pressure produced during the Combustion of Gaseous Mixtures.—MM. Mallard and Le Chatelier.—The authors refer to their paper in the *Comptes Rendus* of October 2, 1882, and call the attention of the Academy to certain observations made on the pressures developed by the combustion of gaseous mixtures in closed vessels.

Ammonium Bihydrosulphate.—M. Isambert.—The author infers from his experiments that this compound is separated, on evaporation, into its two elements. At a given temperature, whether in a vacuum or in an inert gas, the decomposition is arrested by a certain pressure of the component gases.

A Case of Physical Isomerism of Mono-chlorised Camphor.—P. Cazeneuve.—The author has already described a mono-chlorised camphor remarkable for its stability. The examination of the mother-liquor from which this compound has been crystallised disclosed a remarkable case of physical isomerism. The new isomer is soft, like common camphor, and forms a paste under the mortar, whilst the normal mono-chlorised camphor is hard and easily pulverisable. Its rotatory power is $[a]_D = +57$, whilst that of the normal compound $[a]_D = +90$. It melts at 100° , but its normal isomer melts at 83° to 84° .

Reduction of Sulphates by the Sulphuraires, and the Formation of Natural Metallic Sulphides.—M. Planchud.—Certain Algæ acting as a ferment have the exclusive power of reducing sulphates; this reduction never takes place in presence of lifeless organic matter. The author thinks that most of the metallic sulphides found in nature, as well as free sulphur, are the result of the same action.

Transformation of Nitrates into Nitrites.—U. Gayon and G. Dupetit.—The authors have detected the existence of certain anærobic microbia, which do not entirely deoxidise alkaline nitrates, with liberation of nitrogen, but merely take away a portion of their oxygen, and convert them into nitrites.

Poisonous Principles of Esculent Fungi.—G. Dupetit.—The author shows that some esculent fungi, such as *Boletus edulis*, *Amanita caesarea*, and *Agaricus campestris*, are not free from poisonous properties. Their fresh juices, injected subcutaneously, proved fatal to rabbits, rats, and Guinea-pigs. The poisonous principle is a kind of soluble ferment, and is completely decomposed by a temperature of 100° .

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xi., Part xi.

Hailstorms and their Origin.—HH. Rinicker and Dössekell.—The following conclusions are drawn from observations made in Switzerland:—Hailstorms are a local phase of extensive electric storms, and come generally from the south-west, west, or north-west. They do not begin in open plains, but only when, after a long series of hot days, thunderclouds sweep over bare or scantily-wooded heights, and are then brought to a standstill over deep, well-cultivated valleys by the action of counter currents. Hail never arises from storms which have swept over dense, elevated woods of the silver fir (*Abies pectinata*). The more closely wooded the slopes which the storm has to pass over, and the more points the predominating kind of tree presents, the more electricity will be withdrawn from the dense masses of water, and the more they will be deprived of the power of forming ice by further condensation. *Abies pectinata* and *A. excelsa* are more effectual than the larch, the Scotch fir, or broad leaved trees. Most hailstorms come to an end when the clouds pass over a dense wood. The size of the hail-

stones is proportional to the height from which they fall. The size of hazel-nuts represents a height of 100 metres, and the size of walnuts 200 metres. Hailstorms may be to a great extent prevented by keeping the mountain ridges well wooded, and thus facilitating an equalisation of electric action.

Fertility of the Soil as connected with the number of Worms Living in the Arable Stratum.—The author considers that a chemical analysis of the subsoil gives no sufficient clue to its degree of fruitfulness if the number of earth-worms is not taken into consideration. He estimates the quantity of the large kind (*Lumbricus terrestris*) at 50 kilos. per morgen of arable land. In meadows von Lengerke considers that there are per morgen 80 kilos. *L. terrestris* and 250 *L. communis*.

Cause of "Clover-Sickness."—Dr. V. Kutzleb.—The author examines the cause of "clover sickness" occurring in a farm at Winjendorff, and concludes that it cannot be due to a parasitical plant (*Phacidium mediæginis*), since it was in 1880 equally plentiful in fields which showed no trace of "clover-sickness." In 1881 the parasite was much less abundant, but the clover was not more prosperous. The author traces the affection to the want of available potash.

Influence of the Spreading and Heaping of Dung upon the Fertility of Arable Soils.—Prof. E. Wollny.—The author shows that a stratum of farmyard manure protects the soil from excessive alternations of temperature, but acts injuriously upon wet retentive soils, as checking evaporation.

Determination of Fatty Matter in Milk.—Dr. R. Emmerich and D. Ingermann.—Emmerich has compared the gravimetric method with those of Soxhlet and Hoppe-Seyler, and with Feser's optical method, and comes to the result that desiccation with sand and extraction with ether gives results differing from those of Soxhlet by only 0 to 0.4 per cent. Feser's method gives 0.25 to 0.6 per cent in excess.

Examination of Butter with the Margarimeter of Leune and Harbulet.—D. Gaebel.—The instrument is an areometer floating in butter placed in the steam of boiling water. The mark 0 indicates pure butter, and every additional degree that the instrument sinks indicates 1 per cent of foreign fats. The author found that a temperature of 93° to 95° is preferable to 100°, but even then the indications are untrustworthy, a sample of pure butter having on one occasion marked 20°.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3e Série. Tome ix., November, 1882.

This issue contains no chemical matter.

Cosmos Les Mondes.
No. 18, December 30, 1882.

This number contains no chemical matter.

Revue Universelle des Mines, de la Metallurgie, &c.,
No. 1, July and August, 1882.

Volumetric Determination of Copper, Iron, and Antimony by the Processes of M. F. Weil.—Already inserted.

No. 2, September and October, 1882.

Electro-Magnetic Induction.—Eric Gerard.

Use of the Magnetic Needle for the Discovery of Magnetic Ores.—L. Perard.

A Dynamo-Electric Machine with a Solenoid Inductor and a Continuous Current.—J. F. Plücker.—None of these papers are capable of intelligible abstraction without the accompanying illustrations.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 2, 1882.

Determination of the Cinchona Bases and their Salts.—De Vrij has proposed a modification of his well known method, which is here described at length. A. Christensen considers that if large quantities of cinchonidine are present it is advisable to separate the quinine as far as possible by means of ether, and to precipitate it as herapathite. Drygin's method for separating cinchonidine and its homologues from quinine is merely mentioned. H. Hager tests the cinchona bases by the microscopic examination of the precipitates effected by different reagents. A sophistication of quinine ferro-citrate effected by adding amorphous quinine is detected by converting the separated quinine into neutral oxalate, drying carefully, dissolving in chloroform, and filtering, if needful. If a few drops of water are added to this solution in a test-tube the water remains clear if the sample was genuine, but takes a yellow colour if amorphous quinine is present.

Determination of Chlorides in Urine.—G. Firnig.

Determination of Urea with Sodium Hypobromite.—F. A. Falck.

Detection of Phenol in Urine.—T. and D. Tommasi.

Quantitative Determination of Phenol in Urine.—P. Giacosa.

New Reactions of the Biliary Colouring-Matters.—M. Gerhardt.

Trichloroacetic Acid as a Reagent for Albumen in Urine.—A. Raabe.

Determination of Blood-Serum by Circum-Polarisation.—The above papers do not admit of useful abridgment.

Detection of Blood Spots.—An account of spectroscopic, microscopic, and micro-chemical methods for identifying blood spots.

Journal de Pharmacie et de Chimie.
Tome vii., January, 1883.

The Jubilee of M. Dumas.—Taken from the *Comptes Rendus*.

New Facts bearing on the Knowledge of Rabies.—L. Pasteur.—A physiological paper from the *Comptes Rendus*.

The Decomposition of Cyanogen.—M. Berthelot.—From the *Comptes Rendus*.

The Wines of Sugar from a Chemical and Hygienic Point of View.—P. Carles.—The author contends that of all the substitutes for wine the best is that formed by the fermentation of a solution of crystalline cane-sugar poured upon the grapes after their juice has run off. He shows, however, that if glucose is used in place of cane-sugar the product has a dull, flat taste, farinaceous rather than saccharine, with a disagreeable bitter after-taste, and it is, moreover, not free from amylic compounds.

Note on a Brazilian Seed.—A. Riche and A. Rémont. The seed in question, though declared to contain no caffeine, is in a manner recommended for the adulteration of coffee.

Determination of Salicylic Acid in Milk and Butter.—A. Rémont.—Already noticed.

Sulpho-Carbometer for Determining the Quantities of Carbon Disulphide contained in the Alkaline Sulpho-carbonates.—A. Gélis and Thommeret-Gélis.—Already noticed.

Purification of Commercial Zinc Sulphate.—E. Van de Vivère.—The author dissolves the sulphate in water, acidifies with sulphuric acid, transforms any ferrous sulphate present into ferric sulphate by means of a current of chlorine, precipitates a part of the solution with sodium carbonate, and adds the precipitate, previously well washed,

in fractions to the bulk of the liquid, raising the mixture to a boil. The zinc hydrocarbonate eliminates the ferric salt.

Analysis of Aqueous Glycerin.—M. Morawski.—The author heats 2 or 3 grms. of the glycerin with 50 to 60 grms. lead oxide to 130°, until the weight of the mixture remains constant. On multiplying by 1.3429 the increase of weight which the lead oxide has undergone, we obtain the quantity of glycerin contained in the commercial product.

Presence of Allantoine and Asparagine in Young Leaves.—E. Schulze and J. Barbieri.—From the *Journ. für Prakt. Chemie*.

—
Moniteur Scientifique, Quesneville.
January, 1883.

Industrial Society of Mulhouse (Chemical Section),
October 11, 1882:—

M. Noeltig communicated on his own behalf and on that of Dr. Witt a memoir on the preparation of amido-azo-para-toluol and its derivatives.

November 15, 1882:—

M. Horace Kœchlin read a note on indophenol and its use in printing and dyeing.

M. Albert Scheurer communicated researches by M. Grosseteste on the weakening of cotton by heat.

M. Scheurer read a letter from M. H. Schmidt, of Rouen, on the direct application of chromate of lead—yellow, orange, and red—upon tissues. This communication is as follows:—

M. Jacquet has lately pointed out a new process for the chemical fixation of chromate of lead as a steam colour. His process is a clever combination of certain little known properties of the salts of lead and chrome. The author points out another method by which chromate of lead may be fixed upon cloth. He has observed that barium chromate and lead nitrate if mixed together are readily capable of double decomposition on being heated. A steam colour may be made up of a thickened mixture of lead nitrate and of the precipitate obtained from barium chloride and potassium dichromate. The kind of decomposition which takes place is far from being the ideal of a perfect and intimate fixation, since one of the two agents exists in the colour in an insoluble condition; nevertheless, by making use of concentrated colours in a fine state of division and perfectly homogeneous, we obtain yellows which bear soaping. The author exhibited a swatch printed with the following colour:—Tragacanth water (200 grms. per litre), 250 parts; lead nitrate, 250 parts; barium chromate paste (50 per cent), 550 parts; water, 50 parts. To obtain chrome oranges by the same reaction the author has mixed the lead nitrate with a certain quantity of lead acetate, a salt which easily loses its acid, and yields the excess of lead oxide necessary for the formation of basic chromate. He has used colours very rich in lead, utilising the fact that a mixture of lead nitrate and lead acetate is far more soluble than either of these salts taken separately. A mixture of 1 kilo. lead nitrate and 1 kilo. lead acetate may be dissolved in the volume of 120 c.c. without the solution crystallising in the cold, whilst not more than 461 grms. lead nitrate, or 387 grms. lead acetate, separately can be dissolved in a litre of water without crystallisation. The orange colour is obtained with:—Tragacanth water (200 grms. per litre), 500 parts; lead nitrate, 500 parts; lead acetate, 750 parts; barium chromate paste (50 per cent), 1400 parts. By reducing the proportions of lead acetate to 500 or 250 parts yellower shades can be obtained. Lead acetate alone has very little action upon barium chromate. These oranges are more superficially fixed than the yellows, and lose more on washing and soaping. If before steaming they could be calendered the fixation would be more complete, in virtue of the incorporation of the barium chromate in the tissue. Unfortunately, the yellow colour

keeps but a little time, and must be printed the same day that it has been mixed, as in twenty-four hours a large quantity of lead chromate forms in the liquid. The orange colour is more stable, and is still fit for use after the lapse of some days. In working with these colours due precautions must be taken against sulphur fumes. The author exhibited swatches which had been soaped for half an hour at 65°.

M. Camille Kœchlin exhibited a swatch printed with coal, finely ground and thickened with albumen. The colour is a smoke-black, which resists soap and all chemical agents.

On Indophenol.—Horace Kœchlin.

Use of Cœruleine in Wool Dyeing.—A. de Montlaur.—These two papers will be inserted in full.

Review of Biological Chemistry.—G. de Bechi and H. Gall.—A series of translations from the *Berichte der Deutschen Chemischen Gesellschaft, the Journal für Praktische Chemie, &c.*

Review of Foreign Chemical Researches.—G. de Bechi and H. Gall.—Translations from the *Journal of the Chemical Society* and the *Berichte*.

Falsification of Alimentary Matters.—This memoir contains interesting proofs that the sophistication of wines is not an art of modern origin.

—
Bulletin de la Société Chimique de Paris.
No. 10, November 20, 1882.

Double Decompositions of the Haloid Salts of Mercury.—M. Berthelot.—A thermo-chemical study. The author concludes that in presence of hydracids the acid which develops most heat unites by preference with mercuric oxide. This takes place independently of any pretended force, and of all considerations of solubility or insolubility; mercuric chloride being decomposed as well by hydrobromic and hydrocyanic acid, which form soluble salts, as by hydriodic acid, which forms an insoluble salt. The reaction is total if there are formed no secondary compounds, such as acid salts, hydrates, and double salts; these bodies being, further, such that their formation-heat compensates the inequality of their neutralisation-heats, which cannot happen in case of dilute hydriodic and hydrochloric acids. On the other hand, there is a distribution when the formation-heat of the secondary compounds exceeds the difference of the neutralisation-heats which may occur in three manners. In proportion to the formation-heat of the acid hydrates, whenever the liquids contain some quantity of anhydrous acid (in the decomposition of mercuric cyanides by hydrochloric acid)—in this case, the inverse reaction cannot be carried beyond the proportion of anhydrous acid existing in the liquids; or, in proportion to the formation-heat of the acid salts (hydrobromic and hydrocyanic acids)—in this case, the two inverse reactions limit each other, because the acid salts are in part dissociated, and cannot re-form themselves in a reaction beyond the proportion in which they exist in isolation in the presence of water; or, lastly, in proportion to the formation-heat of the double salts. The distribution is governed by laws a little different, according as it gives rise exclusively to soluble bodies or to precipitates. In the former case the action is exerted according to the total weights brought into contact, whilst in the latter case it depends on the proportions which exist at the contact of the liquid and the precipitate.

No. 11, December 5, 1882.

Russian Chemical Society.—Session of April 1/13, 1882.—The Secretary announced that the Iljenkoff prize for researches on the naphtha of the Caucasus will not be awarded by the Council of the Society of the University of St. Petersburg before 1883. The memoirs must be sent in before January 15/27, 1883.

M. Alexéeff gave an account of the following researches

made in the laboratory of the University of Kiev:—On the Structure of the Nitro-Products of the Fatty Series, by M. Kissel; on Azo-oxybenzol, by M. Moltchanowsky.

M. Alexéeff, in his own name and in that of M. Kissel, described the characters of azo-cuminic acid. This acid is distinguished from other azo-acids by its solubility in alcohol and its power of forming fine dark red crystals melting at 262°.

M. Alexéeff pointed out the error of M. de Marignac in considering the crystalline form of azo-benzol as belonging to the clinorhombic type.

The Secretary read a memoir by M. Lideff on the solubility of ammonium gallate, and one by M. Mestchersky on the separation of barium as a neutral chromate from strontium and calcium. The author considers this method as inapplicable to quantitative determinations.

MM. Lideff and Tihomiroff sent in a paper on the formation of hypochlorites and chlorates by the action of an electric current on metallic chlorides.

M. Jawein, on behalf of M. Abraham, described a modification of Gay-Lussac's burette. To the lower closed part of the apparatus is adapted a movable syphon, by means of which the liquid may be made to flow. It is sufficient to raise or lower this syphon in order to accelerate or retard the flow.

M. Goldstein presented some observations on the law of Dulong and Petit.

M. Mendeleeff, in his own name and in that of M. Andreff, made a communication on the coefficient of internal friction of the petroleum hydrocarbides. He presented then some remarks on the combustion-heat of the hydrocarbides. To have an exact idea of the relations between thermic phenomena and chemical transformations it is necessary to separate as far as possible the heat produced by the reaction from that which results from physico-mechanical phenomena. He considers the deductions of M. Thomsen on the relations between the structure of the hydrocarbides and their formation-heat too hazardous.

MISCELLANEOUS.

Society of Arts.—The following papers are set down for reading at the meetings of the Society of Arts during the part of the Session after Christmas:—At the Ordinary Meetings—W. K. Burton, "The Sanitary Inspection of Houses;" General Rundall, "The Suez Canal;" Prof. Thorold Rogers, M.P., "Ensilage in the United States;" Sir Frederick Bramwell, F.R.S., "Some Points in the Practice of the American Patent Office;" J. H. Evans, "The Modern Lathe;" A. J. Hipkins, "The History of the Pianoforte;" Prof. George Forbes, "The Electrical Transmission of Power;" D. Pidgeon, "Recent Improvements in Agricultural Machinery;" Wilfred Cripps, F.S.A., "English and Foreign Silver Work, with some Remarks on Hall-marking." In the Foreign and Colonial Section—Edmond O'Donovan, "Life among the Turcoman Nomads;" Rev. J. Peill, "Social Conditions and Prospects in Madagascar;" Robert W. Felkin, "Egypt: Present and to come;" W. Delisle Hay, "Social and Commercial Aspects of New Zealand." In the Applied Chemistry and Physics Section—C. F. Cross, F.C.S., "Technical Aspects of Lignification;" Walter G. McMillan, F.C.S., "Chemical Means for Preventing or Extinguishing Fires;" W. N. Hartley, F.R.S.E., "Self-Purification of River Waters;" R. W. Atkinson, B.Sc., "The Formation of Diastase from Grain by Moulds;" James J. Dobbie, D.Sc., and John Hutchinson, "On the Application of Electrolysis to Bleaching and Printing." In the Indian Section—Charles H. Lepper, "Overland Commercial Communication between India and China, *via* Assam;" W. S. Seton-Karr, "Agriculture in Lower Bengal: with some Notice of Tenant Right, &c.;" J. M. Maclean, "Private Enterprise in India;" C. Purdon Clarke, "Some Notes on the Domestic Architecture of India."

MEETINGS FOR THE WEEK.

MONDAY, Jan. 22.—London Institution, 5.

Medical, 8.30.

TUESDAY, 23rd.—Royal Institution, 3. "Primæval Ancestors of Existing Vegetation," by Professor W. C. Williamson.

Royal Medical and Chirurgical, 8.30.

Institution of Civil Engineers, 8.

WEDNESDAY, 24th.—Society of Arts, 8. "The Suez Canal," by Lieut.-Gen. Rundall, C.S.I., R.E.

Geological, 8.

THURSDAY, 25th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.

London Institution, 7.

Royal, 4.30.

Royal Society Club, 6.30.

Society of Arts, 8. "Technical Aspects of Lignification," by C. F. Cross, F.C.S.

FRIDAY, 26th.—Royal Institution, 8. "Recent Work on Starfishes," at 9, by Mr. G. J. Romanes.

SATURDAY, 27th.—Royal Institution, 3. "Henry and John Lawrence, 1849—1857," by Mr. R. Bosworth Smith.

Physical, 3. "On Liquid Slabs," by Dr. F. Guthrie. "Absolute Measurement of Electrical Resistance," by Prof. G. Carey Foster. "Spectra formed by Carved Diffraction Gratings," by W. Baily.

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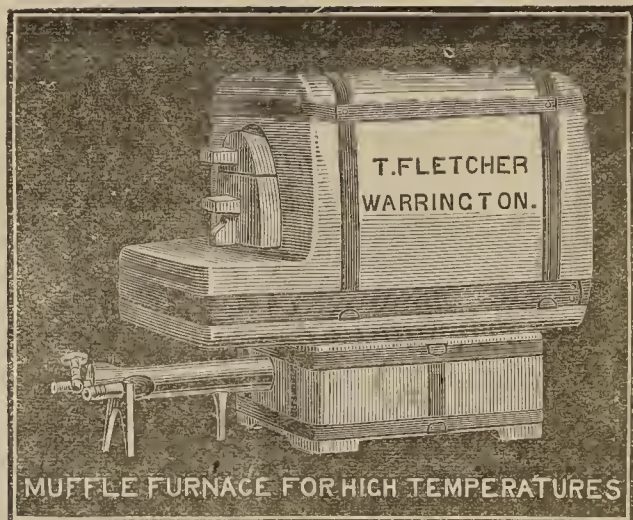
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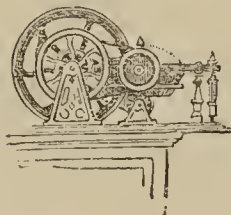
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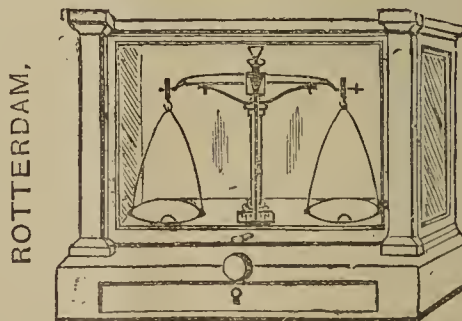
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1209.

NOTE ON A MONO-BROM-HYDRIN OF GLYCEROL.

By V. H. VELEY, M.A. (Oxon.).

THE brom-hydrins of glycerol have hitherto received but little attention from chemists. By the action of phosphorus tri- or penta-bromide on glycerol, Berthelot and De Luca (*Ann. Chim. Phys.* [3], 48, 304) obtained a mono-brom-hydrin (b.p. 180° under 10 m.m. pressure), a dibrom-hydrin, and other products. By the direct addition of bromine to allyl-alcohol a dibrom-hydrin,—

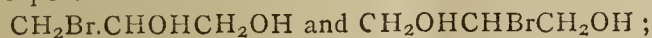


has been prepared by Munder and Tollens (*Ann. Chem. Pharm.*, 167, 224), and others. A few years ago the author studied the action of hydrobromic acid on glycerol: as he has been unable to continue his researches, it is thought not unadvisable to publish this short note.

Dry hydrobromic acid was passed into glycerol, which had been kept over sulphuric acid for several months, until the liquid was saturated with the gas. The crude product was washed with a concentrated solution of potash, and finally distilled under reduced pressure. After several rectifications a mono-brom-hydrin, $\text{C}_3\text{H}_7\text{BrO}_2$, was obtained in the pure state. It is a neutral, oily liquid, boiling at 160° under a pressure of 60 m.m., possessing a faint aromatic smell, insoluble in water, readily soluble in ether. It does not solidify at -15°C .; sp. gr. compared with water at $4^{\circ}\text{C} = 1.717$. Before complete purification it displayed a remarkable green fluorescence; after keeping for some months the same phenomenon was observed. The following results were obtained on analysis:—

	Result.	Theory.
Carbon.. ..	23.05	23.22
Hydrogen	4.8—4.88	4.51
Bromine	51.35	51.60
Oxygen	—	20.67
		100.00

On oxidation with chromic acid mixture it is converted into monobromacetic acid. Experiments were made with a view of converting the brom-hydrin by nascent hydrogen into a three-carbon glycol, and thus deciding between the two possible formulæ—



but from the crude product, obtained by acting upon the mono-brom-hydrin with sodium amalgam and a large excess of water, only acrolein was isolated.

NEW RESEARCHES ON CHLORINE AND BROMINE.

PRELIMINARY COMMUNICATION.

By CARL LANGER and VICTOR MEYER.

THE researches of the last years on the dissociation of the halogens have hitherto yielded decisive results only in case of iodine. V. Meyer has succeeded in carrying the reduction of its density to 4.5,—the half of the theoretical value—and Crafts and Meier have found that this density cannot be further diminished by any increase of temperature or decrease of pressure. Hence it can be considered

as decided that the cause of the decrease of density lies in a progressive dissociation of the iodine molecule.

Such a proof has not yet been furnished for the other two halogens; it can only be inferred from existing observations that the molecules of bromine and chlorine are likewise dissociated at a red heat, but that the dissociation begins at a much higher temperature than in the case of iodine. The lowest density obtained for chlorine in trustworthy experiments in the Perrot furnace is 2.05 in place of the normal value 2.45, whilst for bromine, applied in the free state, certain figures have not yet been obtained.

The authors have begun a new series of experiments to decide whether, under favourable conditions, the densities of chlorine and bromine can be reduced to the half, and whether such reduction, if reached, is the ultimate limit of diminution. In these experiments they have abandoned the process of gaseous displacement as employed by V. and C. Meyer, and instead of employing platinous chloride and platinum bromide, they operate with chlorine and bromine, obtained in the ordinary manner and carefully purified.

The means which they employ, instead of a further increase of temperature (at which the containing vessels would be decidedly softened), consists in the dilution of the heated vapour with an indifferent gas. A notable result may be obtained by this method if we may judge from the results obtained by Horstmann in case of acetic acid (*Berichte*, 3, 78). The gases come in contact only with glass and porcelain, and the chlorine and bromine employed before entering the experimental tube are passed through water, sulphuric acid, and phosphoric anhydride. The bromine had been carefully purified, and was finally distilled in a fractionating flask with a Geissler thermometer, ground into the condenser, and was found to have a perfectly constant boiling-point. The chlorine was prepared with potassium dichromate and hydrochloric acid, and was mixed with the dilution-gas (carbonic anhydride) in a glass gasometer. The porcelain apparatus has been excellently well prepared by Gosse, of Bayeux, and Franz Müller (Geissler's successor) has furnished glass taps which fit air-tight without any lubricant. The working temperatures were: The air of the room, 14° ; watery vapour, 100° ; Fletcher's furnace, without blast, about 900° ; the same with the blast, about 1200° . The density of the undiluted chlorine was at $100^{\circ} = 2.50$; the same, diluted with 5 vols. air = 2.51; diluted with 15 vols. of air = 2.46. The density of undiluted chlorine at $900^{\circ} = 2.49, 2.46, 2.41, 2.46$; and at $1200^{\circ} = 2.41, 2.42, 2.45, 2.47, 2.44$. All these figures agree well with the normal value of Cl_2 , 2.45.

The authors give results as to the density of bromine at low temperatures and great dilution. Bromine boils at 63° , and, as Jahn has proved (*Ber. K. Akademie, Vienna*, March, 1882), possesses, at temperatures which do not lie very high above its boiling-point, a much higher density than the calculated value. It only falls to the normal figure for Br_2 at 230° , i.e., 170° above its boiling-point. Jahn worked with undiluted bromine. If the author's supposition that dilution would promote the dissociation of the halogen molecules be correct, it was to be expected that bromine, much diluted, would show a normal density at low temperatures. This has been fully confirmed. Bromine, diluted with ten times its volume of air, has, at the common temperature of a room, or about 50° below its boiling-point, the exact density calculated for Br_2 .

The authors add a few remarks on chlorine. As far back as 1880 it was shown by the concordant experiments of Crafts, V. Meyer, and Züblin, that chlorine gas prepared in the ordinary manner undergoes up to 1200° no diminution of its density, or but very little. V. Meyer showed that the halogen, if employed in the form of platinous chlorine, retains its calculated density, 2.45, only up to a bright red heat, above which it shows smaller values, which, at about 1400° , fall to 2.05. This fact, which gave rise to the hypothesis that nascent chlorine

is more easily dissociated than the pre-formed element may be, in the opinion of the authors, more simply explained by the conditions of the experiment. In the experiments of V. Meyer and Züblin the pre-formed chlorine was conducted into the apparatus in such a manner as to fill it entirely, and consequently was examined undiluted and possessed the normal density. The platinous chloride was introduced into the apparatus only in such quantity that the chlorine evolved filled the vessel to one-third, or at the utmost to one-half, and was consequently abundantly mixed with air, the dilution occasioning the dissociation observed. Hence we see why M. Crafts, who introduced pre-formed chlorine gas into the apparatus, obtained only a very trifling reduction of density, about 3 per cent.—*Berichte Deutsch. Chem. Gesell.*, xv., 2769.

ON INDOPHENOL.

By M. HORACE KÆCHLIN.

M. O. WITT had drawn the author's attention to Mr. Meldola's violet, and to the attempts which had been made to apply this colour. M. Witt had tried a mixture of nitroso-dimethyl-aniline hydrochlorate and of resorcin or orcin. These compositions were deficient in stability and underwent decomposition in the cold. This inconvenience compelled the author to abandon them, and to try another order of compounds. By substituting for resorcin α -naphthol dissolved in soda the nature of the reaction was changed, but in place of a violet the result was a blue of the tone and the solidity of indigo. The reaction was capable of being reproduced on the fibre, which must be impregnated with α -naphthol sodium at 50 or 100 grms. per litre, and then printed with nitroso-dimethyl-aniline, 50 grms. to a litre of thickening, with 50 grms. of stannous oxide in paste, to steam for fifteen minutes, and to chrome.

The author placed the practical working out of his discovery in the hands of Cassella, of Frankfort, and Durand and Huguenin, of Lyon. These manufacturers generally oxidise a mixture of amido-dimethyl-aniline and of α -naphthol-sodium. Their product is a crystalline powder with a metallic reflexion or a grayish paste, constituting the stannous salt of the reduced compound. Indophenol is insoluble in water; it dissolves in alcohol with a blue colour, and in glacial acetic acid; sulphuric acid dissolves it with a red colour, but decomposes it. Alkalies are without action upon indophenol prepared with α -naphthol, but decompose that from β -naphthol. The mineral acids, on the contrary, decompose the indophenol from α -naphthol, but do not act upon the blue from β -naphthol. There are no other isomers producing colouring-matters whose properties are so different. The indophenol obtained from phenic acid is brighter, and dissolves in sulphuric acid with a blue colour.

From resorcin M. Ch. Mayer has obtained a violet indophenol of great solidity, but wanting in brightness, and difficult to apply on account of its slight solubility.

Indophenol is easily reduced by the sulphides, stannous chloride, &c.; the product of the reduction is very soluble in acetic acid and in the alkalies.

For fixing indophenol upon cotton we print on a mixture of indophenol and tin acetate duly thickened, air and wash, or steam and chrome.

In the first case the author proceeds as follows: he prints the following colour, which has been heated to 50° for half an hour and cooled:—

Indophenol..	..	..	..	..	2000 grms.
Acetic acid, 8° Tw.	..	..	..	..	10 litres.
Tin acetate, 30° Tw...	..	..	..	..	10 "
Gum ..	..	..	..	..	8000 grms.

He ages for twenty-four hours, steams two minutes, chromes at 50° for two minutes (10 grms. potassium di-

chromate per litre of water), and soaps. The steam and the chroming may be omitted, but the colour is less intense.

In the second case he prints:—

Indophenol..	..	..	..	500 to 1000 grms.
Acetic acid, 8° Tw.	..	..	..	5 litres.
Tin acetate, 30° Tw...	..	..	..	5 "
Starch ..	..	..	..	750 grms.
Calcined starch..	..	..	..	750 "
Tin nitro-muriate, 113° Tw.	..	..	..	250 c.c.
Ammonia ..	..	..	..	250 "
Stannous oxide, paste	..	..	..	1 litre.
Black liquor, 14° Tw.	..	..	..	½ "

The pieces are then aged for ten to twelve hours, steamed without pressure for two or three hours, according to the accompanying colours, chromed for two minutes at 50°, with the same strength of chrome as given above, washed, and soaped. More or less of the double salt of tin and ammonia, as well as of the stannous oxide, must be added according to the indophenol. Without these additions the indophenol does not bear steaming.

For dyeing wool, silk, and cotton, mordanted with ammonium sulpholeate, the author dilutes the following bath with water:—

Acetic acid..	..	..	..	1 litre.
Indophenol..	..	..	..	200 grms.
Tin acetate, 30° Tw...	..	..	..	1 litre.
Calcium acetate, 26° Tw..	..	..	..	½ "
Black liquor, 14° Tw.	..	..	..	100 c.c.

Raise to a boil.

The author works the pieces for two hours at 60°, washes, and chromes at 50° for five minutes with 5 grms. dichromate per litre. The pieces are grey as they leave the kettle.

Wool slightly chlored dyes much more readily, giving a blue, which is deeper and resists boiling soap better. Or the wool may be dyed in an alkaline lot by steeping it for two minutes at 50° in—

Water ..	..	..	..	1 litre.
Soda crystals	..	..	..	200 grms.
Indophenol..	..	..	..	25 "
Glucose ..	..	..	..	25 "

Hang it in the air for a few minutes, and take through bichromate of potash.—*Moniteur Scientifique*.

ON CERTAIN TETRA-SUBSTITUTED PROPIONIC ACIDS.

By HENRY B. HILL and CHARLES F. MABERY.

In a previous communication* one of us has already mentioned the fact that the di-bromacrylic from muco-bromic acid, unlike the di-chloracrylic acid of Wallach, takes up a molecule of bromine with readiness and forms a tetra-brom-propionic acid. We were led to undertake a more complete study of the tetra-brompropionic acid. We were led to undertake a more complete study of the tetra-substituted propionic acids, especially with the hope that the study of those containing two different halogens might throw some light upon the position of the halogen atoms in the di-substituted acrylic acids formed from muco-bromic and muco-chloric acids. After our investigations were concluded, Mauthner and Suida† published in the *Proceedings of the Vienna Academy* a paper entitled

* *American Chemical Journal*, 3, 116; and *Proceedings American Academy*, 16 (N.S. viii.), 197.

† *Sitzungsberichte der k. Akademie Wien*, 83, 273.

"*Ueber gebromte Propionsauren und Acrylsauren*," in which they anticipate us in the publication of a portion of our work. Since they were perfectly well aware that, in studying derivatives of a substituted acrylic acid which they asserted, although without adequate proof, was identical with that obtained from muco-bromic acid, they were trespassing upon ground which one of us had already fully reserved, we think it advisable, although it involves a certain amount of repetition, to give our results in full, more especially since we are able to correct their work in several important particulars.

Tetra-brompropionic Acid.

Tetra-brompropionic acid can readily be made by the addition of bromine to di-bromacrylic acid at ordinary temperatures.* We have prepared it by adding to a solution in chloroform the calculated amount of bromine. On standing, the addition product gradually separates, often in large, well-formed prisms. The amount of the product thus obtained was about 90 per cent of the theoretical yield. After re-crystallisation from chloroform the substance was dried over sulphuric acid.

I. 0.5480 grm. substance gave 0.1837 grm. CO₂ and 0.0286 grm. H₂O.

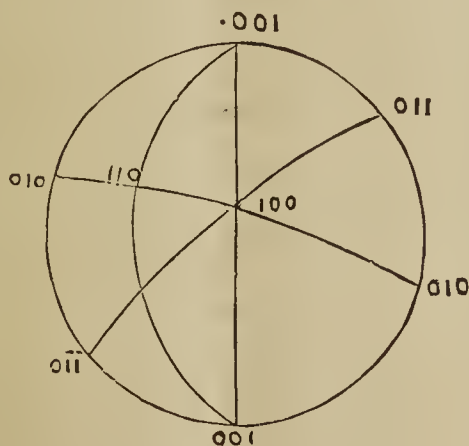
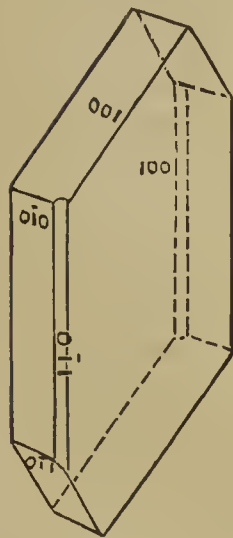
II. 0.1775 grm. substance gave 0.3432 grm. AgBr.

	Calculated for C ₃ H ₂ Br ₄ O ₂ .	Found.	
		I.	II.
C	9.23	9.14	—
H	0.51	3.58	—
Br	82.04	—	82.28

Tetra-brompropionic acid crystallises in prisms of the triclinic system, which melt at 125-126°. It is very soluble in alcohol or ether, readily soluble in hot chloroform, carbonic di-sulphide, or benzol, and separates in crystals as these solutions cool. In ligroin it is sparingly soluble. Under water it melts at a very low temperature to a colourless oil which dissolves freely on heating.

For a crystallographic study of the substance we are indebted to Dr. W. H. Melville.

CRYSTALLINE FORM OF TETRA-BROMPROPIONIC ACID.



Triclinic System.

Forms, [100] [010] [001] [011] [110].	
Elements: Macro-diagonal	$a = 1.507$
Brachy-diagonal	$b = 1$
Vertical axis	$c = 0.934$
Angles of axes	$XY = 94.59'$
	$XZ = 104.28'$
	$YZ = 74.20'$

* Mauthner and Suida assert that the di-bromacrylic acid will take up no bromine in the cold. They prepared tetra-brompropionic acid by heating to 100° with undiluted bromine. That the bromine is very readily taken up one of us first mentioned several years ago (*Berichte der deutsch. chem. Gesellsch.*, 12, 657).

Angles between Normals.

	Observed.	Calculated.
100 and 010	$= 80^{\circ} 48'$	
010 ,, 011	$= 56^{\circ} 3'$	
011 ,, 001	$= 48^{\circ} 51\frac{1}{2}'$	Fundamental angles.
100 ,, 011	$= 77^{\circ} 21\frac{1}{2}'$	
100 ,, 110	$= 57^{\circ} 25'$	
100 ,, 001	$= 77^{\circ} 1'$	
		$76^{\circ} 21'$

Argentio Tetra-brompropionate, AgC₃HBr₄O₂. Argentio nitrate added to a solution of the acid in dilute alcohol precipitates the silver salt in clustered needles, which may further be increased in quantity by the cautious addition of ammoniac hydrate. The salt is extremely unstable, forms argentio bromide on warming, and blackens rapidly in diffused light.

1.2182 grm. of the salt dried over H₂SO₄ gave 0.4744 grm. AgBr.

	Calculated for AgC ₃ HBr ₄ O ₂ .	Found.
Ag	21.78	22.38

Baric Tetra-brompropionate, Ba(C₃HBr₄O₂)₂ · 2H₂O. An aqueous solution of the acid dissolved baric carbonate rapidly in the cold, and if the solution was not warmed there was no noticeable decomposition. On spontaneous evaporation at ordinary temperatures the barium salt was left in clusters of flattened needles. When dried by exposure to the air they contained two molecules of water, which they lost over sulphuric acid.

I. 0.7239 grm. of the air-dried salt lost over H₂SO₄ 0.0272 grm. H₂O.

II. 0.7087 grm. of the air-dried salt lost over H₂SO₄ 0.0259 grm. H₂O.

	Calculated for Ba(C ₃ HBr ₄ O ₂) ₂ · 2H ₂ O.	Found.	
		I.	II.
H ₂ O	3.79	3.76	3.66

0.6756 grm. of the salt dried over H₂SO₄ gave on ignition with H₂SO₄ 0.1742 grm. BaSO₄.

	Calculated for Ba(C ₃ HBr ₄ O ₂) ₂ .	Found.
Ba	14.97	15.16

Calcic Tetra-brompropionate, Ca(C₃HBr₄O₂)₂.—The calcium salt, made by neutralising an aqueous solution of the acid with calcic carbonate and allowing the solution to evaporate spontaneously, crystallised in needles which proved to be anhydrous. The salt freed from moisture by pressure did not materially lose in weight when exposed to the air, and when air-dried lost nothing over sulphuric acid.

I. 0.5065 grm. of the salt dried over H₂SO₄ gave on ignition with H₂SO₄ 0.0888 grm. CaSO₄.

II. 1.0886 grm. of the salt dried over H₂SO₄ gave 0.1850 grm. CaSO₄.

	Calculated for Ca(C ₃ H ₂ Br ₄ O ₂) ₂ .	Found.	
		I.	II.
Ca	4.89	5.16	5.00

When a solution of baric tetra-brompropionate was heated baric bromide was formed, carbonate dioxide escaped, and at the same time the liquid became turbid through the separation of a colourless oil.* On distilling the liquid the oil passed readily over with steam, and since from the method of its formation there could be little doubt that it was tribromomethylen, for identification it was immediately converted into its dibromide by the addition of bromine. The crystalline addition product which was thus obtained when purified by re-crystallisation melted at 53°, and gave on analysis a percentage of bromine which showed it to be penta-bromethan.

0.1696 grm. substance gave 0.3766 grm. AgBr.

	Calculated for C ₂ HBr ₅ .	Found.
	94.12	94.48

* Mauthner and Suida assert that this decomposition also takes place on long standing at ordinary temperatures. They were therefore able to isolate no salts. We have never observed any decomposition in the cold.—*Loc. cit.*, p. 284.

This decomposition may therefore be expressed by the equation:—

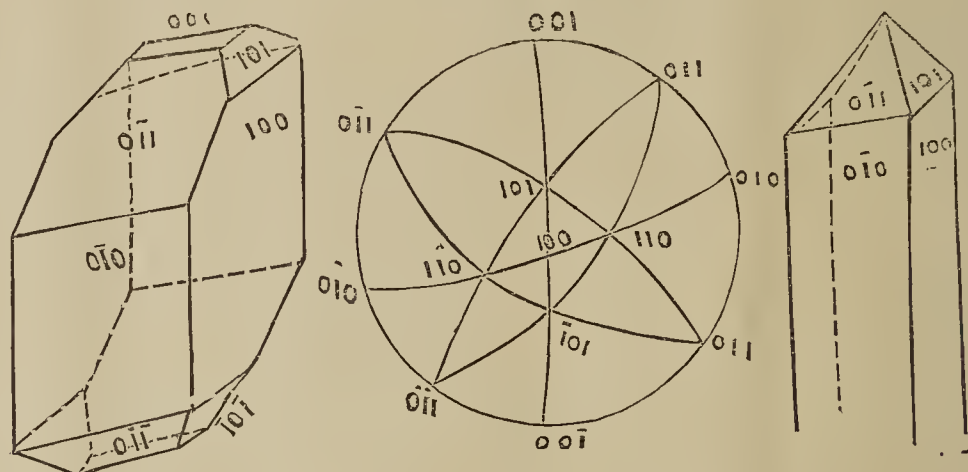


By the action of an alcoholic solution of potassic hydrate upon tetra-bromopropionic acid a molecule of hydro-bromic acid is removed, and there results the tri-brom-acrylic acid, melting at 118° , which we have already described.* Dr. W. H. Melville kindly made a crystallographic study of the crystals which we obtained, and established their identity with those he had previously examined, which were prepared by the addition of bromine to brom-propionic acid. A description of the crystalline form of tri-bromacrylic acid Dr. Melville presents in a separate communication.

Calculated for $\text{C}_3\text{H}_2\text{Cl}_2\text{Br}_2\text{O}_2$.		Found.		
		I.	II.	III.
C	11.96	11.91	—	—
H	0.67	0.90	—	—
Cl	23.59	—	76.93	23.77
Br	53.15	76.74	—	52.90

This α -dichlor-dibrompropionic acid crystallises in well-formed triclinic prisms, which melt at 94° to 95° . It is readily soluble in water, alcohol, or ether; in carbonic disulphide, chloroform, or benzol it dissolves less freely. From a solution in carbonic disulphide it could be obtained by slow evaporation in well-formed crystals, whose study was kindly undertaken by Dr. W. H. Melville.

CRYSTALLINE FORM OF α -DICHLOR-DIBROMPROPIONIC ACID.



α -Dichlor-brompropionic Acid.

In studying the dichlor-acrylic acid made from mucchloric acid, W. Z. Bennett and one of us found that even at 100° it would not take up bromine when dissolved in chloroform.† Subsequently it appeared from the experiments of C. W. Andrews that the substituted propionic acid could readily be made by the action of undiluted bromine, although circumstances at the time prevented a detailed study on his part. As a precise characterisation of this addition-product seemed of interest we undertook its preparation and investigation.

Pure dichlor-acrylic acid melting at 85° to 86° was heated with a molecule of bromine for several hours at 100° . The almost colourless product of the reaction was pressed thoroughly with paper and purified by crystallisation, at first from carbonic disulphide, and finally from chloroform. When dried over sulphuric acid this substance gave on analysis percentages agreeing closely with those required by the formula $\text{CH}_2\text{Cl}_2\text{Br}_2\text{O}_2$. In the indirect determination of the halogens we used the extremely convenient and accurate method recently described by Mr. L. P. Kinnicutt.‡

I. § 0.8124 grm. substance gave 0.3550 grm. CO_2 and 0.0665 grm. H_2O .

II. 0.1715 grm. substance gave 0.3775 grm. $\text{AgCl} + \text{AgBr}$.

III. 0.4790 grm. substance gave 1.0559 grms.

$\text{AgCl} + \text{AgBr}$.

From this by reduction was obtained 0.6887 grm. Ag.

Triclinic System.

Forms, $[100]$ $[010]$ $[001]$ $[101]$ $[011]$ $[10\bar{1}]$ $[01\bar{1}]$; $[110]$ and $[1\bar{1}0]$ often present.

* Elements:	Macro-diagonal	$a = 1.023$
	Brachy-diagonal	$b = 1$
	Vertical Axis	$c = 1.052$
Angles of Axes	$\text{XY} = 91^\circ$	
	$\text{XZ} = 76^\circ 31\frac{1}{2}'$	
	$\text{YZ} = 108^\circ 52'$	

Angles between Normals.

	Observed.	Calculated.
100 and 010 =	$93^\circ 37'$	
100 „ 101 =	$52^\circ 58'$	
010 „ 011 =	$34^\circ 57'$	
010 „ 101 =	$77^\circ 19'$	
101 „ 011 =	$58^\circ 46'$	
100 „ 101 =	$38^\circ 32'$	$38^\circ 41'$
011 „ 001 =	$35^\circ 21'$	$35^\circ 52'$
001 „ 011 =	$55^\circ 45'$	$55^\circ 30'$
100 „ 011 =	$101^\circ 3'$	$100^\circ 39'$
100 „ 011 =	$98^\circ 49'$	$98^\circ 38'$
101 „ 101 =	$87^\circ 34'$	$88^\circ 20'$
101 „ 011 =	$50^\circ 32'$	$50^\circ 30'$

Argentio α -Dichlor-dibrompropionate, $\text{AgC}_3\text{HCl}_2\text{Br}_2\text{O}_2$. The silver salt falls, on the addition of argentic nitrate, to an aqueous solution of the acid, in flattened jagged needles which are readily decomposed by heat. They could, however, be dried over sulphuric acid without any essential decomposition, as is shown by the following analysis:—

* Through an error the ratios of the fundamental parameters were originally given in the *Berichte des deutsch. chem. Gesellsch.*, 14, 1680; $a : b : c = 1.034 : 1 : 1.062$.

* *American Chemical Journal*, 3, 178; and *Proceedings American Academy*, 16 (N.S. viii.), 216. Mauthner and Suida assign to the barium and calcium salts of this acid, prepared by them from tetra-brom-propionic acid, formulæ differing greatly from those which we formerly established by our analyses. Since their determinations were made with small quantities of material, we have not thought it necessary to make further analyses in support of our formulæ.

† *American Chemical Journal*, 3, 172; and *Proceedings American Academy*, 16 (N.S. viii.), 211.

‡ *American Chemical Journal*, 4, 22; and *Proceedings American Academy*, 17 (N.S. ix.), 91.

§ These analyses were made by Mr. Andrews.

0.4885 grm. of substance gave by precipitation with HBr 0.2231 grm. AgBr.

	Calculated for $\text{AgC}_3\text{HCl}_2\text{Br}_2\text{O}_2$.	Found.
Ag	26.46	26.23

Baric α -Dichlor-dibrompropionate, $\text{Ba}(\text{C}_3\text{HCl}_2\text{Br}_2\text{O}_2)_2$. The barium salt we made by neutralising a cold aqueous solution of the acid with baric carbonate. On evaporation at ordinary temperatures it crystallised in long branching needles, which, when dried by exposure to the air, did not lose materially in weight over sulphuric acid, and contained a percentage of barium corresponding to the anhydrous salt.

I. 0.5069 grm. of the air-dried salt gave 0.1606 grm. BaSO_4 .

II. 0.5239 grm. of the air-dried salt gave 0.1676 grm. BaSO_4 .

		Found.	
	Calculated for $\text{Ba}(\text{C}_3\text{HCl}_2\text{Br}_2\text{O}_2)_2$.	I.	II.
Ba	18.59	18.58	18.81

The barium salt is decomposed by warming, its solution giving products similar to those obtained in the same way from tetra-brompropionic acid. This decomposition, however, we have not as yet studied further.

β -Dichlor-dibrompropionic Acid.

Although dibromacrylic acid assumes a molecule of bromine so readily, we found at first great difficulty in preparing the corresponding addition-product with chlorine. If chlorine gas is passed into melted dibromacrylic acid it is gradually taken up and the melting-point of the acid is slowly changed. After long-continued action a considerable quantity of the dichlor-dibrompropionic acid is formed, but so contaminated with oily by-products that its purification is a matter of some difficulty. This addition of chlorine is, however, rapidly and neatly accomplished if the reaction is allowed to proceed in direct sunlight at 100° . When at this temperature the melted acid becomes nearly solid with separating crystals of the addition product, the chlorination is interrupted. The product which we obtained in this way from pure dibromacrylic acid melting at 85° to 86° was purified by crystallisation first from carbonic disulphide, and finally from chloroform. On analysis it gave the following results:—

I. 0.5183 grm. substance gave 0.2335 grm. CO_2 and 0.0431 grm. H_2O .

II. 0.1547 grm. substance gave 0.3400 grm. AgCl + AgBr. From this by reduction was obtained 0.2214 grm. Ag.

		Found.	
	Calculated for $(\text{C}_3\text{H}_2\text{Cl}_2\text{Br}_2\text{O}_2)$.	I.	II.
C	11.96	12.13	—
H	0.66	0.92	—
Cl	23.59	—	23.37
Br	53.15	—	53.21

This β -dichlor-dibrom-propionic acid crystallises in oblique prisms which melt at 113 – 120° , and in its behaviour with solvents closely resembles the α acid. In water, alcohol, or ether it dissolves very easily, but with somewhat more difficulty in carbonic disulphide, chloroform, or benzol. The solution in carbonic disulphide gave by slow evaporation well-developed crystals whose elements Dr. W. H. Melville kindly determined.

Monoclinic System.

Forms, [100] [110] [111] [102].	
Elements: Clino-diagonal	$a = 2.393$
Ortho-diagonal	$b = 1$
Vertical Axis	$c = 1.731$
Angle of Axes	$\text{XZ} = 46^\circ 9'$

Angles between Normals.

Observed.	Calculated.
110 and $\bar{1}\bar{1}0 = 60^\circ 11'$	
111 „ $\bar{1}\bar{1}0 = 42^\circ 24\frac{1}{2}'$	Fundamental angles.
111 „ $\bar{1}\bar{1}0 = 40^\circ 33\frac{1}{2}'$	
$\bar{1}00$ „ $\bar{1}\bar{1}0 = 59^\circ 53'$	
111 „ $\bar{1}\bar{1}1 = 120^\circ \frac{1}{2}'$	$59^\circ 54\frac{1}{2}'$
100 „ $\bar{1}\bar{1}1 = 88^\circ 57'$	$119^\circ 56'$
102 „ $\bar{1}\bar{1}0 = 102^\circ 21'$	$88^\circ 47'$
102 „ $\bar{1}\bar{1}0 = 78^\circ 5'$	$102^\circ 23'$
102 „ $\bar{1}\bar{1}1 = 63^\circ 44'$	$77^\circ 37'$
	$63^\circ 42\frac{1}{2}'$

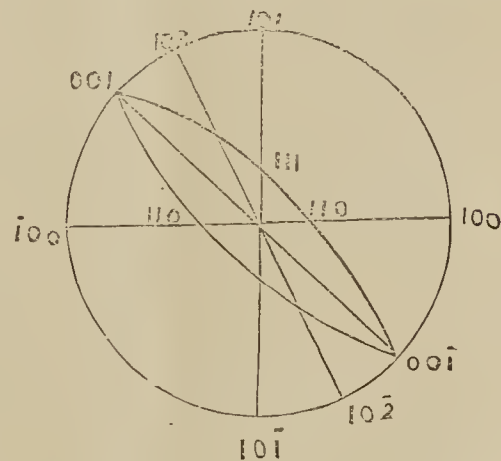
The difference between the α and β acids was further confirmed by a study of the silver and barium salts.

Argentio β -Dichlor-dibrompropionate, $\text{AgC}_3\text{HCl}_2\text{Br}_2\text{O}_2$. The silver salt is precipitated in the form of short, thick, pointed prisms, when argentic nitrate is added to an aqueous solution of the acid. It is readily decomposed by heat, but may be dried for analysis over sulphuric acid.

0.4950 grm. of the salt gave on precipitation with HCl 0.1731 grm. AgCl.

	Calculated for $\text{AgC}_3\text{HCl}_2\text{Br}_2\text{O}_2$.	Found.
Ag	26.46	26.31

CRYSTALLINE FORM OF β -DICHLOR-DIBROMPROPIONIC ACID.



Baric β -Dichlor-dibrompropionate, $\text{Ba}(\text{C}_3\text{HCl}_2\text{Br}_2\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$.

The barium salt, which we made by neutralising an aqueous solution of the acid with baric hydrate, crystallised on spontaneous evaporation of its solution in long radiating needles which were very soluble in cold water. When dried by exposure to the air the salt proved to contain two molecules of water which it lost over sulphuric acid.

I. 1.6201 grm. of the air-dried salt lost over H_2SO_4 0.0705 grm. H_2O .

II. 1.5443 grm. of the air-dried salt lost over H_2SO_4 0.0731 grm. H_2O .

		Found.	
	Calculated for $\text{Ba}(\text{C}_3\text{HCl}_2\text{Br}_2\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$.	I.	II.
H_2O	4.66	4.35	4.74

0.8236 grm. of the salt dried over H_2SO_4 gave 0.2616 grm. BaSO_4 .

	Calculated for $\text{Ba}(\text{C}_3\text{HCl}_2\text{Br}_2\text{O}_2)_2$.	Found.
Ba	18.59	18.69

These results prove that the α - and β -dichlor-dibrom-propionic acids described are essentially different.

Dichlor-dibrompropionic Acid.

	α	β
System of Crystallisation.	Triclinic.	Monoclinic.
Melting-point	94 – 95°	118 – 120°
Barium salt	$\text{Ba}(\text{C}_3\text{HBr}_2\text{Cl}_2\text{O}_2)$	$\text{Ba}(\text{C}_3\text{HBr}_2\text{Cl}_2\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$

The barium salt was readily decomposed by warming its aqueous solution. Baric chloride and carbonic dioxide were formed together with a colourless oil, which undoubtedly was a dibrom-chlorethylen. With bromine this oil gave a solid addition product, which, however, we have not as yet prepared in quantity sufficient for complete purification and identification.—*American Chemical Journal*.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

THE PRESIDENT announced that the following distinguished chemists would be proposed for election at the next meeting of the Society as Foreign Members:—Beilstein, Clève, Debray, Erlenmeyer, Fittig, Helmholtz, Mendeleeff, Lothar Meyer, Victor Meyer. A ballot for the election of ordinary Fellows will also be held at the next meeting, February 1.

The following certificates were read for the first time:—A. C. Abraham, E. Bevan, C. N. Betts, F. J. Cox, A. Collenette, S. Dyson, W. T. Elliott, H. B. Fulton, C. G. Greenfell, B. F. Halford, D. Hooper, W. D. Hogg, H. F. Lowe, T. H. Leeming, J. E. Marsh, W. Newton, C. Rumble, F. Scudder, F. Watts, C. S. S. Webster.

Dr. ROSCOE then communicated the substance of a paper entitled "*The Fluorine Compounds of Uranium*," by A. SMITHELLS. Since the preparation of uranium oxy-fluoride by Berzelius the above compounds have been investigated by Carrington Bolton, and more recently by Ditte. As the results obtained by these two chemists do not agree, the present experiments were undertaken to clear up the question. The green uranoso-uranic oxide, U_3O_8 , when acted upon by aqueous hydrofluoric acid, gives a voluminous green powder and a clear bright yellow solution. According to Bolton this green powder is UF_4 , whilst the yellow solution furnishes, on evaporation, UO_2F_2 . Ditte assigns to the green powder the formula UO_2F_2 , and to the substance in the yellow solution the composition $UF_6 + 8HF$; he also represents the reaction thus— $U_3O_8 + 18HF = 2(UF_6 + 2HF) + UO_2F_2 + 6H_2O + H_2$. The author endeavoured to collect the 2.6 litres of hydrogen which should be, according to Ditte, evolved from 100 grms. of U_3O_8 , but found that none came off. He finds that Ditte is also in error as regards the composition of the other bodies, which are, as Bolton stated, UF_4 and UO_2F_2 respectively. When UF_4 is heated in a closed crucible a white sublimate is formed; if after five minutes the crucible is allowed to cool and the sublimate removed, a fresh sublimate is again formed on re-heating, and so on until a residue is left of UO_2 . This sublimate is isomeric with the body found in the yellow solution, and is called, therefore, α -uranium oxy-fluoride, UO_2F_2 . The author has also investigated the new fluorine compounds obtained by Ditte by fusing U_3O_8 with an alkaline fluoride, and which he stated had the composition $UO_2F_2 + MF$ and $UOF_4 + MF + xH_2O$. The author concludes that these compounds have no existence, and that really only fluoxy-uranates were obtained by Ditte.

The SECRETARY then read a paper "*On a New Method of Estimating the Halogens in Volatile Organic Compounds*," by R. T. PLIMPTON and E. E. GRAVES. The authors introduce a weighed quantity of the liquid into the tube of a glass Bunsen burner; the tube of the Bunsen is bent into a U; over the end of the Bunsen is placed a glass trumpet-shaped tube, the other end of which is connected with a U-tube filled with pieces of glass. These are moistened with pure caustic soda solution. A second U-tube similarly charged succeeds the first. To the

second U-tube is joined a small wash-bottle containing nitrate of silver. A Sprengel pump is connected with the wash-bottle so that the products of combustion are sucked successively through the two U-tubes, and finally bubble through the nitrate of silver solution. The gas having been lighted the liquid is expelled from the weighing-tube by gentle heating. After all the liquid has been thus driven off and burnt, the soda solution is washed out, and boiled with sulphurous acid to reduce any chlorates, &c., nitric acid is added, and the solution precipitated with silver nitrate. The combustion usually takes fifteen to twenty minutes. About 12 analyses are given with liquids of various boiling-points, the lowest being ethyl-bromide, boiling at 39° , the highest acetylene brom-iodide boiling at 150° . The results agree well with the calculated numbers.

Mr. W. A. SHENSTONE then read a short paper "*On a Modified Liebig Condenser*." The Liebig's condenser is placed vertically. To the lower end of the inner tube is fused a short piece of somewhat smaller glass tube. The end of this smaller tube projects upwards about half an inch into the condenser. In this way an annular ledge is formed between the inner wall of the condenser and the outer wall of this smaller tube. This annular space is drained by a narrow glass tube a few inches long, which is fused into the bottom of the condenser like a T-piece. This narrow glass tube slopes gently downwards, and is furnished at its extremity with a stopper. The advantages are first that the apparatus requires less space on the table than the ordinary condensing arrangement, and secondly that when substances have to be digested for some time, and subsequently distilled, no shifting of the apparatus is required. Thus, in the preparation of formic acid by heating oxalic acid with glycerin, the stopper is inserted in the narrow T-tube, and any vapour rising into the condenser, is condensed, trickles down, fills the annular space, overflows, and runs down into the flask. When it is wished to distil the product, the stopper is taken out, and the liquid, instead of running back into the flask, drains off from the annular space down the narrow T-tube into the receiver. The apparatus is made by Cetti and Co.

The SECRETARY then read a paper "*On Two New Aluminous Mineral Species, Evigtokite and Liskeardite*," by W. FLIGHT. The first mineral comes from the cryolite bed of Greenland. The author gives its formula as $Al_2F_3 + 2CaF + H_2O$. It resembles chalk or kaolin in its appearance. Liskeardite is obtained as a white crystalline mineral with tinge of blue, from Penzance. It has the formula $3R_2O_3As_2O_5 + 16H_2O$, $R = Al$ and Fe . The author has made a very minute and careful determination of the water expelled at various temperatures.

The SECRETARY then read a paper "*On the Volume Alteration attending the Mixture of Salt Solutions*," by W. W. J. NICOL. The author has investigated the changes of volume in mixing various proportions of sodium and potassium chlorides, of potassium nitrate and sodium chloride, of sodium nitrate and potassium chloride, and of copper sulphate and potassium sulphate. The experiments show that when two salt solutions which cannot experience double decomposition are mixed, a change of volume takes place due to the different affinity of the salts for water; that double decomposition takes place in solution, and that the volume change is an index, and even a measure, of this decomposition.

The Society then adjourned to February 1.

SOCIETY OF PUBLIC ANALYSTS.

THE Annual Meeting of this Society was held at Burlington House on January 17, when the election of Officers and Members of Council took place.

Mr. G. W. WIGNER, who has occupied the position of one of the Honorary Secretaries since the formation of the Society, more than eight years ago, was elected President,

and Mr. C. Heisch, Dr. C. A. Cameron, and Dr. Alfred Hill, Vice-Presidents. The new Honorary Secretaries elected are Mr. Bernard Dyer and Mr. Otto Hehner; and other new Members of Council are Mr. A. Ashby, Mr. C. T. Kingzett, and Dr. P. Vieth.

Mr. A. P. Stokes, of Paddington, was elected a Member of the Society.

Mr. HEHNER read a very interesting paper "*On the Analysis of Yellow Wax.*"

The Annual Dinner was afterwards held at the "Criterion," where the Members and their friends passed a very agreeable evening.

NOTICES OF BOOKS.

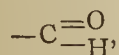
Die Chemische Kraftquelle im lebenden Protoplasma.
(The Chemical Source of Force in Living Protoplasm.)
By OSCAR LOEW and THOMAS BOKORNY. Munich:
Jas. Ant. Finsterlin.

SINCE synthetical chemistry got its start in 1828 by the discovery, by Wöhler, of the artificial production of urea, so many of those compounds have been formed in the laboratory which were formerly supposed only capable of being produced by the mysterious power called "vital force" with which living organisms were endowed, that the artificial formation of albumen would not seem to be an impossibility for the synthetical chemist. Citric acid and indigo have but recently yielded to his efforts, and sugar, starch, or even albumen, may at some not far distant date be another important victory in this field of research. It is, however, doubtful if substances such as albumen, which plays so important a part in the life of a cell, produced artificially, would possess the same physical properties as those which exist in living organisms. The composition of the two might agree, but to give to the artificial article that organised structure which the natural substance possesses in the active state called life will doubtless transcend the powers of the human intellect.

That there is a chemical difference between living and dead protoplasm, as was first inferred by E. Pflüger, in 1875, from theoretical considerations, is considered by the authors of the present work to be true.

This pamphlet forms the second edition of the authors' work, "The Chemical Cause of Life," with the title changed, and contains the results of their speculations regarding the origin and constitution of albumen, with the experimental evidence they have adduced of a chemical difference existing between living and dead protoplasm. Under the expression protoplasm they understand only the organised watery albumen of the cell-contents, the other substances present being considered merely as mixtures of greater or less importance.

The aim of the work is to prove the existence of an aldehyd group,—



in living protoplasm, which after death undergoes an alteration of molecular structure. In their theoretical considerations formic aldehyd is made the starting-point for obtaining the formula for albumen. The proof of the aldehydic character of living protoplasm is based on the fact that living cells are capable of separating silver from a very dilute alkaline solution of the metal, whilst dead cells give no such reaction. The detailed experiments were made principally with cells of *Spirogyra* under various conditions, and in two coloured plates appended to the work is shown the influence which living cells exert on the silver solution employed, and the negative results obtained with cells that had been killed by various physical and chemical means. To such a vast subject of enquiry as this is, of which our knowledge is so vague and opinions so divided, we have no doubt that this pam-

phlet, containing an attempt to establish a chemical difference between dead and living protoplasm, will form an interesting contribution, and probably give rise to further experiment in the same direction.

Through the kindness of the authors we have had the pleasure of examining a number of their prepared specimens, and they would seem to be of great interest from a biological as well as a chemical point of view.

The Retrospect of Medicine; being a Half-yearly Journal containing a Retrospective View of Every Discovery and Practical Improvement in the Medical Sciences. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. LXXXVI., July to December, 1882. London: Simpkin, Marshall, and Co.

THIS volume contains no small quantity of matter of interest to the sanitarian. We find an abstract of an essay on the diseases caused by sewer gas, in which the gaseous products of the decomposition of animal matter are acquitted, when in a diluted state, of causing serious disease. The true morbid agents are very rationally pronounced to be "formed" ferments—microzymes—which are of two classes at least. There are the ferments of putrefaction which may occasion low sore-throat, diarrhoea, and other non-specific diseases common in places exposed to sewage emanations. Then there are what the writer calls the microzymes of specific diseases, such as diphtheria and typhoid fever, which are only incidentally present. It is, however, hinted as at least probable that these more dreaded poisons may be generated *de novo* where sewage is allowed to stagnate. The extraordinary changes which certain microbia have been found capable of undergoing in the course of a few generations lends probability to this view. It is far from unlikely that microzymes normally harmless may, under favouring conditions, develop into the germs of specific disease.

The sanitary value of sulphur is expounded at some length in a paper by M. d'Abbadie, which we have already noticed in an abstract of the *Comptes Rendus*.

Concerning typhoid fever and diphtheria, we find the remark that "these diseases have grown with the growth and developed with the development of our present water-closet system," which has been pronounced a way of laying on sewer-gas into every household. This is a very serious charge, but it appears to be built upon facts carefully observed in various places. Very few water-closets are constructed in the best known manner, and even when the builder has tried the unusual experiment of honest work the fact remains that a water-joint is no absolute barrier to the interchange of gases.

A paper by Dr. A. Key, of Montrose, conveys a grave warning how even intelligent efforts to place and maintain a house in a good sanitary condition may be baffled. Eight severe cases of diphtheria occurred in a farmhouse near that town. The house was built on a rising ground facing the sea, and the drainage was faultless. The water for drinking, cooking, &c., was obtained from a well near the sea, the water of which had been submitted to analysis and pronounced pure. There was no water-closet in the house, and the privy at the bottom of the garden was clean. Yet previous to the attack of diphtheria there had been, during twenty years' occupation of the farm, seven outbreaks of typhoid fever. Dr. Key at last noticed a pond which served to contain water for the threshing-mill, and which was offensive. A pipe had been unfortunately carried from this pond into the kitchen, to supply water for washing, &c., though the servants had been strictly charged never to use it for drinking or cooking. The cook, however, confessed that, to save trouble, she had often used this infected water for making soup, &c.! *Hinc illæ lachrymæ.*

Other cases mentioned in the book before us all teach the same lesson.

Year-book of Pharmacy; comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, contributed to British and Foreign Journals, July 1st, 1881, to June 30, 1882, with the Transactions of the British Pharmaceutical Conference at the Nineteenth Annual Meeting, held at Southampton, August, 1882. London: J. and A. Churchill.

THIS volume opens with a general survey of the progress of pharmacy, and of such departments of chemistry as are most closely connected therewith, during the past year, especial attention being paid to the organic bases.

In the section on chemistry we note the remark that "the artificial production of indigo may even now be said to be within measurable distance of commercial success." This statement scarcely agrees with the recent admissions of Prof. Baeyer, as given by the *Chemiker Zeitung*.

Under the head "Materia Medica and Pharmacy" we find it mentioned that the importation of Indian opium into China is being considerably reduced, not from any decrease in the consumption, but in consequence of the extending use of native-grown opium and of that derived from Persia.

Some of the paragraphs placed under "Pharmacy," e.g., that on "Ericine," the alleged yellow dye obtained from heath, might have figured quite as suitably under the section on "Chemistry."

In the Presidential Address, delivered at the Conference, attention is called to the wide sale of secret and proprietary medicines, distributed by persons who have often no knowledge of drugs, and who in some cases are not even legally responsible for the harm that may be caused by their use. At a subsequent meeting, Dr. Symes having read an interesting paper on certain Brazilian drugs, Mr. Groves "asked if Dr. Symes had experimented with these drugs on any of the lower animals; but he presumed he would require a license before operating even on a mouse. It appeared to him a great obstacle to science that a simple matter like this, which Dr. Symes had been kind enough to bring forward, could not be dealt with satisfactorily in consequence of the action of the anti-vivisectionists. A dose of this medicine could not be given to a mouse, although it might do the mouse good, in consequence of the existence of the Act of Parliament!"

Prof. Redwood, in commenting upon a notice of some advanced sheets of the new American Pharmacopœia, remarked that in receipts and formulæ "parts by weight" were preferable to any system of weights, traditional or metric.

The Brewer, Distiller, and Wine Manufacturer. By JOHN GARDNER, F.I.C., F.C.S. London: J. and A. Churchill.

THIS work is one of "Churchill's Technological Handbooks," and appears to have grown out of "Cooley's Cyclopædia of Practical Receipts and Collateral Information in the Arts, Manufactures, Professions, and Trades." The publishers remark in their announcement that some persons are unwilling to purchase an Encyclopædia when they only desire to consult a limited portion of it, whilst others seek for fuller information than could be afforded in a work of such scope. The name of Mr. Gardner does not appear, indeed, on the title-page, but as he appends his signature to the "Editor's Preface," he must be practically regarded as the author.

The first chapter of the work is devoted to "Alcohol and Alcoholometry." The editor treats of the preparation of absolute alcohol and of hydrated or commercial alcohol, using ordinary "spirit of wine" as a starting-point. Mention is also made of the synthetic production of alcohol by the action of olefiant gas upon sulphuric acid as effected by Henel and Berthelot, and from the treatment of acetyl chloride with glacial acetic acid in presence of sodium amalgam (Saytzeff and Linnemann).

Jullien's process for obtaining alcohol from madder-root can scarcely now lay claim to practical importance,

since the cultivation of madder appears to be approaching its end. Prior to the introduction of artificial alizarin it may have been of value.

The chemical properties of alcohol, the methods for discovering impurities present, and for its recognition in toxicological cases are next given. The instructions laid down for the last-mentioned purpose are too brief to be of value to anyone not already conversant with such operations. The author remarks that "the use of methylated spirit in the preparation of tinctures, sweet spirits of nitre, ether, or any medicine for internal use is prohibited by law." Yet it is well known that such methylated alcohol is employed for medicinal uses, and Mr. H. B. Hewetson (*Lancet*, July 1) maintains that the ether from methylated spirit is safer and more efficient for the production of anæsthesia than the ether from a pure alcohol.

The subject of alcoholometry is dealt with at very considerable length.

In the chapter on beer and its materials we read—"A malting at the present time is but the counterpart of what it was fifty years ago. This is the more astonishing, since malsters were never tired of inveighing against the malt-tax when it was in existence, and urging the many improvements which were possible if it were only removed." Perhaps if malt were the only material from which beer might be legally made these improvements might have been carried into effect. But we believe the English malster has found the effects of the repeal of the malt-tax somewhat different from what he anticipated.

Under cider we find mention of the unpleasant fact that much of what is sent to London contains a dose of alum.

Under "Liqueurs and Cordials" there is mention of the manufacture of absinthe. Sulphuric acid, and "another very dangerous ingredient," i.e., antimony, are said to be occasionally introduced. We doubt, however, whether either of these sophistications can be more dangerous than the oil of wormwood itself. We are surprised that none of our temperance reformers demand the total prohibition of its importation into or sale in Britain—a step which would be sound policy.

In the chapter on the "Distillation of Alcoholic Liquors" we are told—"In France, Germany, and Denmark, large quantities of spirits of good quality are manufactured from potatoes." Concerning the quality of potato-spirit some doubt may be entertained. It is so rich in amylic alcohol that in some parts of North Germany, Poland, &c., it is familiarly spoken of as "fusel." It is interesting to see the Polish peasant gulp down this spirit with a shudder provoked by its nauseous flavour, the only inducement being its great intoxicating power. Beet-root spirit, as the author mentions, is also rich in fusel-oil.

In the chapter on "Wine and Wine Making" we meet with a doubtful statement—"The vine thrives best in a warm loose soil composed of argillaceous marl, lime, chalk, and gypsum, pervious to air and water." We have always been accustomed to regard the vine as a potash plant, affecting volcanic soils and such as result from the decomposition of felspar, as in the Greek Islands, Southern Italy, the Rhine, &c.

We are glad to find that Mr. Gardner denounces the evil practice of "plastering" wines. This industrial sin could be easily suppressed, as far as the United Kingdom is concerned, were it enacted that all wines containing more sulphuric acid than the proportion naturally present in the juice of the grape should be destroyed.

The work before us may upon the whole be pronounced to be accurately and carefully compiled, and likely to prove of great service to the very numerous persons interested in the wine, beer, and spirit trades.

Detection of Sodium Sulpho-rosanilate.—R. Kayser. Amylic alcohol extracts a colouring-matter the solution of which shows the spectrum of rosaniline.—*Zeitschrift*.

CORRESPONDENCE.

THE CLOSING OF BOTTLES.

To the Editor of the Chemical News.

SIR,—The remarks on the loss of volatile liquids from stoppered bottles (CHEMICAL NEWS, vol. xlv., p. 286) induce me to ask you to publish, for the information of any chemists who have not tried the plan, the use of the caoutchouc caps sold at the india-rubber shops as coverings for the fingers of men using acid liquids, which are made of two sizes, called in trade "finger-stalls" and "thumb-stalls," being of the sizes to go on the forefinger and thumb of a working man. I constantly use these as caps for bottles for any liquids or gases which do not act on caoutchouc. They press closely on the neck of the bottle, and can be drawn off at once when it is to be opened; or they can be made very tight by wiring if it is to be kept long closed.—I am, &c.

HENRY B. GIBBINS.

Neath, January 18, 1883.

RUBERINE.

To the Editor of the Chemical News.

SIR,—In reference to my letter in the CHEMICAL NEWS (vol. xlv., p. 23), the Editor of the *Journal of the Chemical Society* has pointed out to me that the inaccuracies complained of were purely printer's errors and not due to any omission in the MS. of the abstract, which I have seen and is perfectly correct.—I am, &c.,

T. L. PHIPSON.

London, January 23, 1883.

BLOWPIPE ANALYSIS.

To the Editor of the Chemical News.

SIR,—In an article which appeared in the CHEMICAL NEWS (vol. xlv., p. 283), Lieut.-Col. Ross has so completely misquoted a passage from my "Manual of Blowpipe Analysis" that I feel constrained to correct him.

After giving, in his own way, my description of a well-known qualitative test, which he wrongly regards as long and complicated, he closes by representing me as stating to the student that he "will not find it easy to follow accurately the above changes in the appearance of the melted button of arsenides, especially if it is small." What I actually wrote was this:—"The beginner will not find it easy to follow accurately the above changes in the appearance of the melted button of arsenides, especially if it is small, but the progress of the operation can always be easily followed if," &c.

By omitting the end of my sentence the Lieut.-Colonel has made me appear to state the exact opposite of what I did state, and to that I object, even when it is done in support of a system of Pyrology. I may add that until yesterday I was unaware of the existence of his "little manual, published in 1880," although I have examined his earlier work.—I am, &c.,

H. B. CORNWALL.

John C. Green School of Science, College of New Jersey,
Princeton, January 6, 1883.

A CORRECTION.

To the Editor of the Chemical News.

SIR,—Will you allow us to call attention to certain inaccuracies and omissions in the paper presented by us to the French Academy of Sciences, an abstract of which appeared in the CHEMICAL NEWS, vol. xlv., p. 251. The formula of mellogene is incorrectly given (doubtless through

a printer's error) as $C_{14}H_2O_4$ instead of $C_{11}H_2O_4$. We find no allusion to our experiments on graphitic acid, which we obtained in abundance by electrolysis, using an acid solution with an electrode of graphite.

We would also wish to take the present opportunity of referring to an abstract published in the CHEMICAL NEWS, vol. xlv., p. 25, of a paper by Dr. Tommasi, in which he makes special allusion to our investigations. In the paper presented by us to the French Academy of Sciences we made no claim of priority as one would be led to believe in reading the last lines of the abstract inserted in your journal. We limited ourselves to a simple description of our researches into the various combinations exhibited by oxygen and carbon under electrolysis. In a note which accompanied our paper to the French Academy we expressed surprise that Dr. Tommasi, in his communication to *Comptes Rendus*, p. 790, 1882, should have called attention, with an almost prophetic air, to the combinations which might occur between oxygen and carbon when subjected to the electric current, whilst he was at that very time aware of our researches.

As regards our discovery of the various compounds and combinations alluded to in our paper, it was unnecessary for us to claim any priority in that respect, seeing that such priority had never been disputed.

Notwithstanding what we have above written, we may further add that Dr. Tommasi, in the *Revista Scientifico-Industriale*, and in the *Orosi*, a chemical and pharmaceutical journal, both of Feb. 21, 1881 (but not in the *Nuovo Cimento*, as he would lead us to believe by his communication to the CHEMICAL NEWS), writes as follows:—"Far from me any intention of claiming by my present note any right of priority in the investigations, &c.," and if you will have the goodness to refer to *Comptes Rendus*, May 29, 1882, No. 22, you will find that Dr. Tommasi writes—"A propos d'une réclamation on pouvait dire *observation faite* par MM. Bartoli et Papasogli au sujet du note precedente qu'il n'a pas eu l'intention de contester leurs droits de priorité."

We shall feel much obliged by your publishing the above remarks, which are of importance in their bearing upon the mellogene formula, whilst they will also set at rest all doubts as to priority in the discovery, and which would never have arisen had it not been for the abstract of the paper by Dr. Tommasi published in your journal.—We are, &c.,

DR. G. PAPASOGLI.
DR. A. BARTOLI.

Instituto Tecnico-Florence.
January 9, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Bulletin de la Société Chimique de Paris.
No. 11, December 5, 1882.

Russian Chemical Society.—Session of April 1/13. —M. Butlerow presented a communication on the oxidation of iso-dibutylene by potassium hypermanganate, and a note on atomic weights. In view of the anomalous results obtained by M. Schützenberger with the carbides of the petroleum of the Caucasus, benzine and aniline—results which may be explained by admitting the variability of atomic weights,—M. Butlerow thought it necessary to explain the manner in which he regarded this hypothesis. He described the experiments which he had undertaken in conjunction with M. Rizza on the atomic weight of chlorine after isolation, and of chlorine kept in the dark. He has sent a note on this question to the Chemical Society of Paris.

Determination of Salicylic Acid in Milk and Butter.—A. Rémont.—The author agitates 20 c.c. of the milk with 2 or 3 drops of sulphuric acid in a test-tube. The agitation should be strong enough to break up the clot and form a homogeneous mixture; 20 c.c. of ether are poured in, gradually at first, and the whole is shaken up until the ether is emulsified only in part. After standing, 10 c.c. of the ethereal solution are decanted into an ordinary test-tube having a mark corresponding to a volume of 10 c.c. The ether evaporates, leaving a residue of butter, which is boiled with 10 c.c. of alcohol at 40 per cent, and is then allowed to cool. We have thus 10 c.c. of solution containing all the salicylic acid of an equal volume of milk. It is poured upon a filter, and 5 c.c. are received in a graduated tube of 0.015 metre in diameter; 2 or 3 drops of ferric chloride (diluted with 100 parts of water) are added, and the intensity of the violet colour obtained is compared with that of an analogous liquid prepared from pure milk to which known proportions of sodium salicylate have been added. Butter is examined in a corresponding manner.

Nitrogen Selenide.—M. Verneuil.—The author mixes up 10 grms. selenium perchloride with a few drops of carbon dichloride, and the paste obtained is suspended in a litre of the same solvent. A current of dry ammoniacal gas is directed into the liquid; flakes of ammonium chloride are precipitated, and the liquid gradually takes a decided rose colour. It is well to agitate the liquid frequently. The red colour gradually disappears, and there are deposited brown flocks, a mixture of ammonium chloride and probably of a compound of selenium, and nitrogen selenide. The current of ammoniacal gas is continued until these flocks turn to a fine light orange. The whole is then filtered, washed with carbon disulphide, the mass pressed in linen, and the product dried in a current of air. The orange powder obtained is a mixture of ammonium chloride and nitrogen selenide. The former body is removed by washing in water, and the product, after drying in the air, is finally purified with boiling carbon disulphide. The composition of the selenide is expressed by Se_2N . It is a light orange amorphous powder, insoluble in water, ether, and alcohol, very slightly soluble in carbon disulphide, benzol, and glacial acetic acid. When dry, it detonates if struck with a hard body, and explodes if heated to 230° . It is decomposed by potassa, whilst the liquid retains potassium selenite and selenide, and all the nitrogen escapes as ammonia. It is slowly decomposed by boiling water.

No. 12, December 20, 1882.

Russian Chemical Society.—Session of April 29/ May 11, 1882.—M. Wroblewsky announced that symmetrical nitroxyline is transformed by oxidation into nitroiso-phthalic acid. He also gave certain experimental data confirming the formula of benzol as proposed by M. Ladenburg.

M. Sokoloff presented, on behalf of M. Gué, a communication on the nitric ethers of lactose.

M. Menschoutkine gave an account of his researches on the formation and decomposition of acetanilide.

M. Jawein, on behalf of M. Wilm announced that amongst the metals of the platinum group, as obtained by reduction by means of hydrogen from their ammoniacal compounds, or the double salts which they form with ammonium chloride, platinum is the only one (except osmium and ruthenium) which does not become oxidised when heated to bright redness in a current of air. The other metals readily absorb oxygen, forming lower oxides. Thus a given weight of pure palladium gained 6.68 per cent. If the heating of the metal is continued, the increase of weight ceases as soon as the palladium is converted into a homogeneous deep grey mass, corresponding to the sub-oxide Pd_2O , and containing 6.99 per cent of oxygen. The oxidised metal may be reduced at the ordinary temperature by a current of hydrogen. Under the same conditions metallic rhodium absorbs 12.96 per

cent of oxygen, forming a black sub-oxide, RO , containing theoretically 13.29 per cent of oxygen. Iridium reduced from the pure iridium-ammonium chloride absorbs 4.55 per cent of oxygen. The formula IrO would require 7.47 per cent, and Ir_2O only 3.88 per cent. The value found seems to refer to an intermediate oxide, $\text{Ir}_2\text{O} + \text{IrO}$.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xi., Part 12.

The Influence of the Structure of the Soil upon its Thermometric and Hygroscopic Relations.—Prof. E. Wollny.—The author distinguishes a powdery and a crumbly condition of soils, the former state occurring in land which has never been under cultivation, or has been left to itself for a number of years, or has to be frequently dug over. The crumbly soil is such as is in a state of normal cultivation. As regards the moisture in the soil he concludes that the proportion of water in a soil and the degree of evaporation from its surface increase directly as the fineness of the particles. During the warm portion of the year the soil is warmer the coarser it is. At or below freezing-point the reverse holds good. A coarse soil, however, thaws more rapidly, and is more readily warmed in spring.

Agricultural Use of the Slag obtained in the Basic Dephosphorising Process.—Such slag on analysis was found to contain 19 per cent of phosphoric acid. It cannot be advantageously rendered soluble with sulphuric acid, as it quickly "goes back." A large part of the phosphoric acid originally present is soluble in ammonium citrate, and may hence be considered as available for plant food. As the presence of large quantities of ferrous and manganese salts may make its direct application to the crops unsafe, the author recommends that it should be spread early in autumn on fields which are to be sown in spring. Or it may be scattered over dung heaps.

Experiments on Sugar-Cane with Artificial Manure.—E. Riffard.—From the *Revue des Industries*.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 3, 1882.

New Method for Determining the Ignition-Point of Petroleum.—Leo Liebermann.—This paper requires the accompanying figures.

Ignition-Point of Petroleum Admissible in Practice.—Leo Liebermann.—From a study of the maximum temperatures naturally occurring, the author concludes a petroleum, the flashing-point of which exceeds 60° , may be safely used in all parts of Europe.

A New Method for Determining the Sulphur in Coal-Gas.—Dr. O. Knublauch.—This important paper cannot be reproduced without the accompanying figure.

Determination of Phosphoric Acid by the Molybdc Method.—Drs. Stünkel and Wetzke and Prof. Wagner.—This paper is reserved for insertion in full.

The Action of Potassium Dichromate upon Potassium Iodide, and the Alkalinity of Alkaline Dichromates.—M. Richter.—The author has discovered that potassium dichromate and iodide if dissolved in water react in such a manner that potassium monochromate is formed, whilst free iodine is separated out. If the solutions of both salts are concentrated the iodine is deposited in crystals. The author endeavoured to found upon this reaction a volumetric method for the determination of potassium dichromate, estimating the liberated iodine in the known manner by means of a solution of sodium hyposulphite, and then finding by calculation the corresponding quantity of potassium dichromate. He soon reached the view that the decomposition is only partial, and that a considerable time is required for the complete conversion of the dichromate into the mono-

chromate, and abandoned the process, but returned to it again in consequence of the researches of E. Donath (*Zeitschrift Anal. Chemie*, xviii., p. 78). The latter chemist maintains that the separation of iodine is due to the presence of free chromic acid. M. Richter has therefore repeated his experiments with dichromate free from free chromic acid, and with potassium iodide containing neither potassium iodate nor free iodine, but obtained the same results as before. For greater certainty the experiment was performed in an atmosphere of hydrogen, and the water used had been freed from dissolved oxygen by repeated boiling. The reaction may be employed for detecting dichromates present in monochromates, especially if potassium iodate is added along with the potassium iodide. Mohr has investigated the same reaction (*Zeit. Anal. Chemie*, xi., p. 278), but, like Donath, concludes that no iodine is set free, and cites this reaction in support of his opinion that the dichromate is not an acid, but a neutral salt. M. Richter, on the other hand, has succeeded in showing by means of phenol-phthaleine that the monochromate possesses no basic properties, and must be regarded as the neutral salt.

Decomposition of Nitrous Oxide and of a Mixture of Nitrous Oxide and Nitric Oxide at a Red Heat. A. Wagner.—The author examined if nitrous oxide can be determined by means of its oxidising action upon an ignited mixture of chromium sesquioxide and sodium carbonate in the absence of air, and was completely successful. The nitrous oxide decomposed can be determined either by the volume of the nitrogen liberated or by the quantity of sodium chromate formed, since 1 vol. nitrous oxide yields 1 vol. nitrogen, and 1 part chromium oxide requires 0.3136 oxygen for conversion into chromic acid. The author found by especial experiments that by heat alone, in the absence of the mixture of sodium carbonate and chromium sesquioxide, only 28.2 per cent of the nitrous oxide is decomposed. A mixture of equal vols. nitrous and nitric oxide is entirely decomposed under the same conditions, giving up all its oxygen, whilst any excess of nitric oxide escaped unchanged.

Volumetric Determination of Ferrous Oxide in Hydrochloric Solution by Means of Potassium Permanganate, and the Question of Chemical Induction in General.—Fr. Kessler.—The author points out that the experimental results of Ciemens Zimmermann (*Zeit. Anal. Chemie*, xxi., p. 108) have been anticipated by his own researches published in *Poggendorff's Annalen* (cxviii., p. 48, and cxix., p. 225). This phenomenon, along with many analogous facts, the author explains by the general principle that mutually indifferent bodies existing in solution together may be rendered active by transformations taking place in the same liquid. This process, following the example of Bunsen, he calls "chemical induction." Thus the oxygen dissolved in water, tolerably inactive as regards stannous chloride, is rendered active if this salt of course in hydrochloric solution, is converted into stannic chloride by means of permanganate or chromic acid. The author mentions the paradoxical case that chromic acid may act as a reducing agent. If a few grammes potassium antimony tartrate are dissolved in water, and hydrochloric acid added to prevent turbidity, ferric chloride and potassium ferricyanide if present do not react upon each other. But if a few c.c. of chromic acid be added the liquid turns blue.

Testing Butter.—Dr. J. Munier.—The author criticises the original process of Hehner, and the modification proposed by Reichert (*Zeit. Anal. Chemie*, xviii., p. 68), which he finds untrustworthy. From a series of analyses carried on during an entire year it appears that the proportion of volatile acids fluctuates with the season, and is lowest in October, November, December, and January. In February there was a sudden and well-marked increase of the fatty acids, which continues till August, and then gradually declines. Hence different limits must be established for the different seasons.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Vitriol Chamber.—A subscriber wishes to know the proportions of a chamber necessary to make 650 lbs. of 66° Baumé sulphuric acid per diem from Italian sulphur, where there are seven months cold weather, three temperate, and two hot?—SUBSCRIBER.

Precipitation of Carbonate of Lime from Water.—Some time ago I saw it stated in a report by Dr. Angus Smith on the water around Manchester that caustic soda would precipitate carbonate of lime from water. Having reason to doubt this, I made strong solution of carbonate of lime in water by means of carbonic acid gas, and afterwards added some solution of NaHO, but failed to get a precipitate. I also tried the effect of adding NaHO to a water containing carbonates and sulphates of lime in equal proportions, and got a precipitate of the sulphate, but it did not touch the carbonate. Dr. Smith also states that if NaHO be added to a water containing CaCO_3 and CaSO_4 , the NaHO will combine with the CO_2 which holds the CaCO_3 in solution, forming Na_2CO_3 , which in turn will act on the CaSO_4 and cause a precipitate of CaCO_3 , leaving Na_2SO_4 in solution. Would any of your contributors kindly state if this is the case, as I have tried the experiment and do not get these results.—W. G.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 29.—London Institution, 5.

Medical, 8.30.

Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field, F.C.S.

TUESDAY, 30th.—Royal Institution, 3. "Primæval Ancestors of Existing Vegetation," by Professor W. C. Williamson.

Institution of Civil Engineers, 8.

Society of Arts, 8. "Life among the Turkoman Nomads," by Edmond O'Donovan.

WEDNESDAY, 31st.—Society of Arts, 8. "Ensilage in the United States," by Prof. Thorold Rogers.

THURSDAY, Feb. 1st.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.

London Institution, 7.

Royal, 4.30.

Chemical, 8. Ballot for the Election of Fellows. "Some Derivatives of Fluorene," by W. R. E. Hodgkinson, Ph.D., and F. E. Matthews, Ph.D.

FRIDAY, 2nd.—Royal Institution, 8. "The Size of Atoms," by Sir William Thomson, at 9.

Geologists' Association, 7.30. (Anniversary).

SATURDAY, 3rd.—Royal Institution, 3. "Sir John Lawrence and the Mutiny, 1857," by Mr. R. Bosworth Smith.

TO CORRESPONDENTS.

W. G.—To give the tables referred to would nearly fill a number of the CHEMICAL NEWS.

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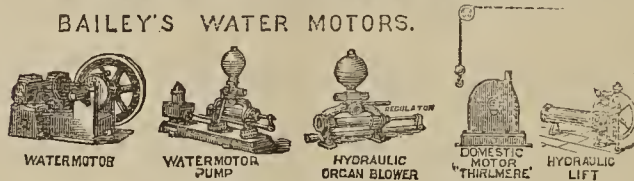
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THE CHEMICAL NEWS

AND

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VOL. XLVII. No. 1210.

MODIFICATION OF ONE OF THE PROCESSES FOR THE ESTIMATION OF THE AVAILABLE CHLORINE IN BLEACHING-POWDER.

By J. W. CHALMERS HARVEY.

ONE of the methods which Fresenius recommends for the expeditious estimation of the available chlorine in bleaching-powder consists in dissolving a weighed quantity of iron wire in hydrochloric acid, diluting the solution of ferrous chloride thus obtained up to about 200 c.c. with water, and determining in the number of c.c. of the bleaching-powder solution which is required to convert the ferrous into ferric chloride.

The equation is $2\text{FeCl}_2 + 2\text{Cl} = \text{Fe}_2\text{Cl}_6$.

The bleaching solution is prepared by making 10 grms. of the bleaching-powder into a thin paste with water in a porcelain mortar, adding more water, transferring to a litre flask, and making up to this measure. 1 c.c. = 0.01 bleaching-powder.

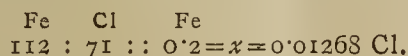
The modification of this process which I propose does away with the necessity of weighing out a certain quantity of iron and dissolving to ferrous chloride. The basis of this method consists in adding a measured quantity of a dilute solution of stannous chloride to a solution of ferric chloride; this latter must be in excess.

The reaction is $\text{Fe}_2\text{Cl}_6 + \text{SnCl}_2 = 2\text{FeCl}_2 + \text{SnCl}_4$.

The iron converted into the ferrous condition is then estimated by a standard solution of potassium bichromate. A known amount of ferrous chloride can thus be formed immediately.

Conduct of Process.—Add the same measured quantity of stannous chloride as in the standard experiment to an excess of a solution of ferric chloride. Dilute this solution up to about 150 c.c. with distilled water and titrate with the solution of bleaching-powder (previously well shaken) until a drop taken out ceases to give a blue or bluish-green colour with potassic ferricyanide. The amount of chlorine which the ferrous chloride formed by the stannous chloride will require for its conversion into ferric chloride is found by the following calculation.

Suppose the iron found by the bichromate, and corresponding to the stannous chlorine added, to be 0.20 gm., then—



Suppose, further, that 47 c.c. bleaching-powder solution have been used to oxidise this amount of iron, then they must have contained the above quantity of chlorine; then as each c.c. = 0.01 bleaching-powder—

C.c. Grms. B.P. Cl B.P. Chlorine.
47 = 0.47; then if 0.47 : 0.01268 :: 100 : x = 26.97 p.c.

The following are the results of some experiments executed in this manner compared with others attained by dissolving iron in hydrochloric acid in the usual way.

Usual way.	Modification.
27.47	27.45
27.43	27.42
—	27.45

The requisites for the foregoing modification are:—

1. Solution of stannous chloride.—This is prepared by dissolving 60 grms. in HCl with the aid of heat and making up to 1 litre. 5 c.c. of this solution are sufficient for each experiment. The amount of ferrous chloride to

which it corresponds should be determined before each series of assays, as stannous chloride is very prone to change.

2. Solution of ferric chloride.—This must be absolutely free from ferrous chloride, and may be made by dissolving red hæmatite (as pure as obtainable) in hydrochloric acid, or iron wire in the same acid, oxidising this latter with potassic chlorate, and evaporating off excess of chlorine.

3. Standard bichromate.—Dissolve 30 grms. in hot water, cool, and make up to 2 litres, 1 c.c. = 0.017 gm. iron.

Maryport, Cumberland, Jan. 22, 1883.

PRESENCE OF TELLURIUM IN COPPER.*

By T. EGLESTON, Ph.D., New York City.

SOME months ago, samples of black oxide of copper and of pig-copper from Colorado were sent to me to examine for arsenic and antimony. I examined them both by the blowpipe and in the wet way, but found none present. A quantity of this material was purchased by a large metallurgical works; but when they attempted to refine it, they pronounced it to be full of arsenic and antimony; so much so, that their furnaces were, as they said, "poisoned," and rendered unfit for refining. I then re-examined the samples, and at the same time some of the material which had "poisoned" the furnaces, and found no traces of arsenic or antimony when the usual amounts for analysis were used; but on taking very large amounts I found traces merely, in some parts of the sample, but not in all. As it was a matter of interest to ascertain what the white substance that "poisoned" the furnace was, I sent to the works making the black copper, and obtained some of the matte from which the black copper was made. I took careful samples both of it and the black copper and the refined copper. I then found the impurity to be tellurium, a substance not heretofore known as occurring in copper. I give below one analysis of the matte, two of the black, and one of the refined copper:—

	Matte.	Black copper.		Refined copper.
Copper.. ..	55.02	97.120	98.090	99.705
Gold	0.06	—	—	—
Silver	0.40	0.132	0.128	0.135
Lead	17.87	0.777	0.757	none
Zinc and nickel ..	2.22	0.070	0.100	0.024
Iron	4.18	0.130	0.080	0.031
Sulphur	20.02	0.236	†	trace
Tellurium	0.12	0.093	0.097	0.083
Arsenic	†	0.006	†	0.091
Slag, &c.	—	1.270	0.192	—
	99.89	99.834	99.444	100.069

The mattes and the black copper are results of the treatment of copper ores with the tellurium ores of Colorado. In the laboratory, no traces of white fumes were shown on charcoal; but when the metal in the furnace was subjected to the process of "dry roasting," as was unintentionally done, very dense white fumes were given off. When refined and cast into cake, it had the ordinary appearance of cake copper. It was then re-heated for rolling in the ordinary way, showing no signs of impurity. At the first pass in the rolls, very fine cracks showed themselves, which opened in succeeding passes. At a thickness of about 0.03 metre, the cracks on each side nearly penetrated the cake, and at about 0.008 metre it began to fall to pieces. It was heated and rolled at different temperatures, but always with the same result. When cold, the metal is tough and malleable. Although

* A Paper read at the Harrisburg Meeting of the American Institute of Mining Engineers.

† No traces were found with the blowpipe.

the cakes in the moulds showed no coating, when they were heated repeatedly and allowed to cool in the air they became covered with a white powder, which proved to be the oxide of tellurium. The copper, as it comes from the cake-moulds, has every appearance of being good copper.

This is the first time, so far as I know, that the presence of tellurium has been detected in commercial copper. But very little of it is removed in the treatment, as the four analyses show. It is surprising how very small a quantity renders the copper red-short, and consequently worthless for rolling.

ON BISULPHIDE OF CARBON.

By L. H. FRIEDBURG, Ph.D.

SEVERAL years ago I published some notes on bisulphide of carbon (*Berichte d. Deut. Chem. Gesell.*, viii., 1616), to which I shall now add a few more observations. Then and there I showed how to clean the bisulphide by means of fuming nitric acid, and that the vapours of nitrous acid, of nitrogen dioxide, of sulphurous acid, &c., were taken up and invariably retained by the bisulphide. Dry bisulphide of carbon serves as a very good conveyance for the reaction of such gases and vapours in a dry state on each other and on other substances. The only disagreeable feature in this regard is that carbon disulphide in most cases also enters the reaction, forming very undesirable products and sometimes only such sulphur containing products are formed in any notable quantity. The following reactions are the only three I wish to mention, as they may prove germs for further investigations.

1. Bisulphide of carbon charged with the vapours of nitrogen dioxide and then mixed with pure benzol, forms amongst other products large broad crystals of dinitro-benzol, melting at $+86^{\circ}\text{C}$. These crystals are formed after standing a considerable time, and after the partial evaporation of the mixed liquids at summer heat.

2. I think that great interest is attached to the reaction of the afore-mentioned liquids in direct sunlight. The brown vapours begin to disappear without escaping from the narrow neck of the very large flask, in which such experiments take place, and in proportion as they disappear, small white crystals begin to cover the sides of the flask within. This covering principally takes place above the edge of the liquid on the bare glass. The crystals could not be analysed, because they decomposed when brought in contact with air, yielding then NO_2 and benzol. It is not entirely out of the way to suppose that in this case addition-products formed, analogous to benzol-hexachloride $= \text{C}_6\text{H}_6\text{Cl}_6$, so that the white crystals in this case might be either $\text{C}_6\text{H}_6(\text{NO}_2)_4$ or $\text{C}_6\text{H}_6(\text{NO}_2)_6$, which of course needs further investigation.

3. A very pretty reaction takes place when bisulphide of carbon charged with dry sulphurous acid gas, and the same medium charged with nitrogen dioxide (which was not free from nitrous acid) are brought together. This reaction might be used as a lecture experiment. Keeping the vessels cool and dry (I generally use a spacious beaker), white crystals very readily form in considerable quantity, which, in fact, are nothing but lead chamber crystals. This reaction treated analytically may some day throw new light on the formation and composition of lead chamber crystals.

The bisulphide of carbon cleaned by means of fuming nitric acid is the only chemically pure I came across, and I therefore proceeded to determine its specific gravity as well as boiling-point, without finding, though, any differences from any former determinations.

The specific gravity at $+15.2^{\circ}\text{C}$. is 1.266, and the boiling-point $+47.4^{\circ}\text{C}$., at 0.760 m. pressure.

The pure bisulphide shows materially no other so-called physical properties than those known heretofore.

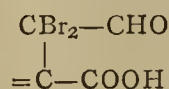
Finally, I want to state that in treating raw bisulphide of carbon, coming from the retorts of manufacture, with fuming nitric acid, I could invariably detect mono-nitro-benzol in the residue of evaporation, which leads me to believe that amongst the numerous products formed in the red-hot retorts, particularly if the charcoal was not dry enough, there is also benzol.

2. The purifying influence of a non-coloured and inodorous fat, for instance, such as the oil of African palm kernels, good as it is for the bisulphide of carbon, becomes a nuisance when this latter is used as a means of extraction of the former. I advise, therefore, from long experience, all those who extract fats (particularly if it is for manufacturing) by means of CS_2 never to use an excess of this latter, and never to let a new mixture of oil and bisulphide run into the still in which oil already freed from bisulphide is retained. This latter will else be rendered impure.—*Journal of the American Chemical Society*, November, 1882.

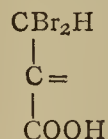
ON THE CONSTITUTION OF THE SUBSTITUTED ACRYLIC AND PROPIONIC ACIDS.

By HENRY B. HILL.

WITHIN a few years the number of substituted acrylic and propionic acids known has been largely increased, and yet the constitution of but few of these can be said to be satisfactorily established. In a previous communication I was led to adopt provisionally for mucobromic acid the formula—



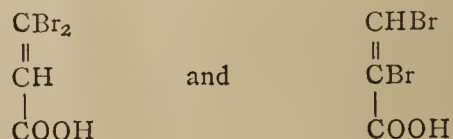
which explained its connection with maleic acid, in whose molecule the researches of Fittig had shown the probable existence of a dyad carbon atom. The structure of the related dibromacrylic acid was then naturally expressed by the formula—



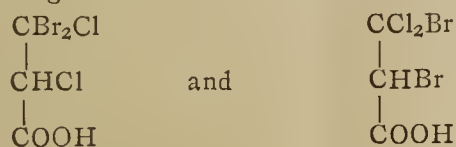
against which at the time nothing more convincing than a belief in its improbability could be urged. The relations which Andrews and I have shown to exist between this same acid and two different tribromopropionic acids prove, however, that this formula is incorrect. An acid with this structure could be formed from but a single tribromopropionic acid, and must of necessity give this same tribromopropionic acid by the addition of hydrobromic acid. The same objection also applies with equal force to the other two conceivable formulæ for dibromacrylic acid which contain dyad carbon—



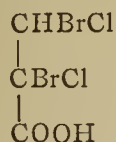
and these must consequently be rejected. There remain therefore for the acid in question but two possible formulæ—



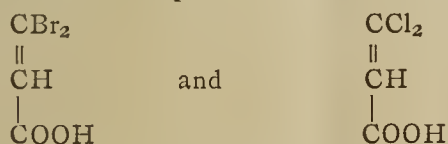
The formation of two isomeric dichlor-dibrompropionic acids by the addition of chlorine to the dibromacrylic acid and of bromine to the analogous dichloracrylic acid, as Mabery and I have shown, would seem again to be decisive in favour of the first of these formulæ, since its adoption would give—



as the structure of the two isomeric dichlor-dibrompropionic acids, while the second formula would give in either case the same compound—

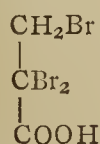


Although it was by no means impossible that a molecular re-arrangement had taken place in one of these two reactions, still it seemed improbable, since the reactions were apparently neat, and in the treatment with chlorine, where such a change would be more naturally expected, no bromine could be detected in the escaping chlorine. On the other hand the adoption of the formulæ—



for the derivatives of mucobromic and mucochloric acids presented difficulties quite as serious. In the first place, the dichloracrylic acid of Wallach had been proved beyond all doubt to be different from that which Bennett and I had described by a comparison of the crystalline form of the two acids, and it would follow then that Wallach's acid could not have the formula he assigned to it. The formation of an acid with different structure from chloralid could, however, be explained upon the assumption that the chlor-propionic acid was the first product of the reduction, and that this passed, on the one hand by the addition of hydrogen, into the β -chloracrylic acid, and on the other hand formed dichloracrylic acid by addition in the subsequent treatment with strong hydrochloric acid which Wallach prescribes.* Although this hypothesis was far from satisfactory, it seemed to me hardly more improbable than that a similar molecular rearrangement had taken place in the reaction which had come under my own observation.

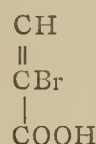
Still another difficulty was to be found in the formation of the dibromacrylic acid in question from the tribrompropionic acid melting at 92° , which, if the ordinarily accepted formula for the latter—



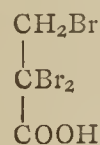
were correct, would prove the incorrectness of the formula assumed. I was at first unable to attach any great importance to this argument, inasmuch as the constitution of the monobromacrylic acids was extremely uncertain. For although the discovery by Wallach of the β -monobromacrylic acid melting at 115° had rendered the constitution of the α - and β -monobromacrylic acids of Tollens extremely doubtful, it by no means proved their identity.

Erlenmeyer has, however, recently shown† that the α - and β -acids of Tollens, as well as their potassium salts, crystallise in identical forms, and the structure of the

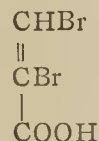
tribrompropionic acid melting at 92° is therefore put upon quite another footing. Since the same (α) monobromacrylic acids can be made from α -dibrompropionic and also from its isomer, the α - β -dibrompropionic, it follows that this acid must have the structure—



and the the tribrompropionic acid made from it by the addition of bromine must of course have the corresponding form—

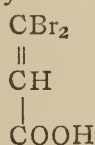


Since the formulæ with dyad carbon are in this case excluded, there remains for the dibromacrylic acid in question only the structure—

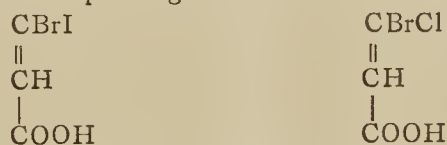


Although this conclusion is directly at variance with the results which Mabery and I obtained in the study of the dichlor-dibrompropionic acids, it must be confessed, I think, that it is probably correct. Still, since its adoption presents undoubted difficulties, I shall endeavour to bring more direct experimental evidence as to its correctness.

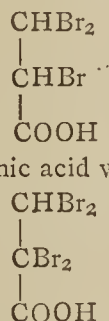
The dibromacrylic acid of Fittig and Petri, which, as Mabery and I have shown, can be made from brompropionic acid, would naturally have the form—



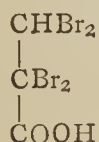
and the acids made in the same way containing two halogens the corresponding—



The tribrompropionic acid melting at 118° would be written—



and the tetrabrompropionic acid would have the form—



—*American Chemical Journal*.

Examination of Butter.—Th. Munzel.—The author heats exactly 1 grm. of pure butter fat with 12.5 grms. absolute alcohol in a test-tube till completely dissolved. The tube is then closed with a cork passing down almost to the bottom. When the butter is dissolved, the outside of the test-tube is wiped, and the author, holding it loosely in his hand, notes the temperature at which congelation sets in. With pure butter this ensues at 34° , and in such containing 30 per cent of lard at 43° . Olæ-margarin from the Frankfort Company congeals at 56° .—*Zeitschrift*.

* *Annalen der Chemie*, 193, 7.

† *Berichte der deutschen chemischen Gesellschaft*, 14, 1867.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, January 27th, 1883.

Prof. CLIFTON, President, in the Chair.

NEW Member—Mr. Hugh E. Harrison.

Prof. G. CAREY FOSTER read a paper "*On the Determination of the Ohm*," in which he described the various methods which have been used and proposed in determining the B.A. unit of resistance. He also described a method of his own, proposed in 1874, and recently tried with good results. The method consists in balancing the E.M.F. set up in a coil of wire by spinning it in the earth's magnetic field, against the E.M.F. of a battery or other electromotor in a wire whose resistance is to be determined. The two opposing circuits through this wire, R, are composed, the first of the spinning coil and a zero galvanoscope, and the second of a battery and an absolute galvanometer, these two circuits meeting at the ends of the wire R. The late Mr. Hockin and Prof. Foster find that the best conditions obtain when the resistance of the absolute galvanometer, r_1 , is equal to R; the resistance of the zero galvanoscope r_2 equal to $\frac{R}{2} + r_3$; and the resistance of the spinning coil r_3 many times the battery resistance, which should be so low as to be practically negligible. The E.M.F. of the battery should be double that of the spinning coil. Many other conditions had to be attended to, as explained by Prof. Foster. With this method, and using a thermo-electric battery giving an E.M.F. of 2.2 volts, the coil was spun at about 1800 revolutions per minute; r_1 was 63 ohms; r_2 was 135; r_3 was 50; and R was 73 in one and 80 in another experiment. R was made up of coils in a resistance box. The ohm was determined by two trials to be 1.003 and 0.999. This general result is so satisfactory that the experiments will be continued with extra precautions.

Mr. GLAZEBROOK called attention to the remarkable agreement between the results of Lord Rayleigh's determinations and his own independent ones. Lord Rayleigh's figures are for the unit—0.9893, 0.9865, 0.9868, and Mr. Glazebrook's is 0.9866, or the mean of Lord Rayleigh's results. He also announced that the Clarendon Laboratory, Cambridge, would soon be in a position to test and certify any resistance coils sent there.

Mr. WALTER BAILY then read a paper "*On the Spectra formed by Curved Diffraction Gratings*." In a diffraction grating ruled on a portion of a cylinder, if r is the distance of a point from the centre of the grating, and θ the angle which a line to the point makes with the perpendicular from the centre of the grating, c the radius of curvature of the grating, and d an arbitrary constant, a series of curves may be drawn in the plane perpendicular to the lines of the grating, having as the general equation—

$$r^{-1} \cos^2 \theta = c^{-1} \cos \theta + d^{-1}$$

If a source of light is placed on a point on one of these curves, all the foci of the diffracted light lie on the same curve. The curve consists of two loops, one of which gives the spectra of transmitted, and the other those of refracted, light. When d is infinite these curves coincide in a circle, the properties of which have been used by Prof. Rowland in the construction of his diffraction spectro-scope. The paper also described how the position of the spectra on the curves could be determined for any position of the source of light.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, December 28th, 1882.

Mr. B. S. PROCTOR, President, in the Chair.

THE minutes of last meeting were read and confirmed.

Mr. H. A. Kay was elected a member of the Society.

The name of Mr. John Tilley, Goods Manager, North-Eastern Railway, North Shields, was read for the first time.

Dr. H. S. Pattinson and Mr. T. W. Hogg were elected as Scrutineers of the voting papers.

The evening was devoted to the exhibition and explanation of apparatus, &c, and the following notes and descriptions were read:—

Stearn's New Form of Illumination for the Microscope.—Exhibited by Mr. J. B. PAYNE, F.R.M.S.—Your kind attention is asked to a new adaptation of the electric light,—the illumination of microscopic objects by means of Swan's Incandescent Electric Lamp in place of oil or gas,—the origination and adaptation of which is due to Mr. C. H. Stearn, F.R.M.S. It is claimed for this new form of illumination that the trouble in cleaning and preparing the oil lamp, and the unpleasant heat and smell given off by it, is in this lamp entirely avoided; that the light is of purer quality; that the great ease and facility with which this lamp can be adjusted is beyond comparison with the ordinary oil or gas lamp, especially when it is required to change the position of the light to above or below the stage, as for opaque or transparent objects; and that condensers may, to a great extent, be dispensed with, thus also saving much trouble.

The lamp is calculated to give from one to three candle power, and is readily controlled by means of a small resistance coil of iron-wire interposed in the circuit.

The best form of battery is, undoubtedly, the Grove or Bunsen, two cells being generally sufficient, three ample.

When the lamp is used in special places, such as a drawing-room for instance, and the battery has to be placed in the same room, where the fumes from a Bunsen's battery would be objectionable, the Leclanché battery may be employed, or, better still, an accumulator. I have used a four-cell Leclanché battery, and also a modification of the bichromate battery with much success. Of course those persons who have adopted electric lighting for their residences, or laboratory, will only require to attach a connection to the supply, and will not need a battery.

In Mr. Stearn's microscope the lamp is permanently attached to, and made a portion of, the instrument, the body of the microscope forming one connection. Three lamps are fitted—one above the stage, revolving round its own axis; one below the stage, fitted on to the sub stage; and one fixed below the sub stage, for use with the polariscope. Each lamp is connected to a three-way switch, enabling the operator to alter the position of the light with the greatest ease and freedom. But as I do not think everyone would like to go the expense of having this elaborate installation made, I have arranged fittings which can be used with the stand condenser, or simply fixed on to the stage by means of a clamp or a pin like that used with the stage forceps. By means of either of these fittings the little lamp can be easily and quickly transposed to any required position. In accordance with a promise given to Mr. Stearn, I am not permitted to do more than point out the principal features of this new form of microscope illumination, as he is anxious that I should not forestall a paper which he is to deliver in London next month.

Kühne's Model Eye for Demonstration Purposes.—Exhibited by Mr. C. E. STUART, B.Sc., for Messrs. BRADY and MARTIN.—This consists of a long rectangular trough which can be filled with water or other medium. The front end is provided with lenses and diaphragms of appropriate shape to represent the cornea and the crystalline

lens; hollow glass lenses are provided to receive the fluids serving as aqueous and vitreous humours, and a movable ground glass screen takes the place of the retina. With the help of movable lenses of various shapes, which stand in the trough, all the different peculiarities and defects of vision, and the principles of the methods by which they are remedied, can be demonstrated to a class, perfect or defective vision being recognisable by clearness or blurring of the real images of external objects formed upon the ground glass plate.

Acid-resisting Bricks.—Exhibited by Mr. JOHN MORRISON.—It occurred to me a few days ago that a sample of the Welsh bricks, which are now beginning to be adopted in Lancashire and other chemical manufacturing centres, for resisting the action of acids and alkalis, might be of interest to this meeting; and my friend Mr. Gibson, of the Buckley Brick and Tile Company, has kindly, at my request, forwarded me the two blocks now on the table.

As most present are, I dare say, aware, Welsh fire-bricks are of two kinds, the blue or "C.S." and the white or "S.S." bricks, the former containing most alumina and iron, and the latter being the more expensive.

Until within the last three or four years Welsh bricks, so far as I am aware, were little, if at all, used for "Glover Towers," the pressed blue Staffordshire bricks being almost universally employed. The Buckley Brick and Tile Company, however, having found, after a number of experiments, that they could produce a dense and very slightly porous brick, which they believed could favourably compete with the Staffordshire brick, put up machinery for preparing them on a manufacturer's scale.

Some two years ago I was entrusted with the erection of sundry plant for the Connah's Quay Alkali Company, which included a pair of "Glover Towers"; but when the manager (Mr. Steedman) seemed inclined to try the Buckley bricks for their lining, I must confess I was at first very much opposed to what appeared to me to be a serious risk. After, however, carefully examining the process of manufacture, and after Mr. Steedman had boiled a brick for two months continuously in sulphuric acid, and found that no perceptible action had taken place, my prejudices began to give way, and the "metalline" bricks and blocks (as they are called) were finally adopted, not only for the lining, but for the arches of the towers.

I am glad to be able to say that up to the present time these towers are perfectly efficient, and that when, twelve months after their erection, an opportunity occurred of examining the arches, they were found to be, as Mr. Steedman expressed it, "as sound and perfect as on the day they were put in"; and, I have no doubt, they will last for eight years, if not even longer.

These bricks are now used also pretty extensively for revolver linings and "breakers," not merely in Lancashire, but in Yorkshire, Scotland, and Germany.

Revolver linings, $5\frac{1}{2}$ inches thick, have lasted three to four years.

Large circled blocks have also been successfully employed for neutralising wells; but for that purpose, when Yorkshire flags are obtainable, I should hesitate about recommending them.

I fancy a good deal of their efficiency is consequent upon their non-porosity and almost absolute imperviousness to the internal action of alkalis or acids.

The absorptive power of bricks, even for water, varies very much, and in building bricks this is, in fact, the chief measure of their durability.

I remember, two or three years ago, immersing samples of the chief local brands of pressed fire-clay facing-bricks for twenty-four hours in water, and being rather surprised to find that, of the two best known and most expensive makes, one only absorbed 6 ounces of water, but the other no less than 13 ounces.

The metalline bricks are, I believe, prepared from mixtures of the best Welsh clays, according to the purpose for which they are designed. This mixture, after proper treatment, is introduced into a conical cylinder, and car-

ried to the narrow end by means of a revolving screw. At this end the dies are fixed, and the clay is forced through them by means of an ordinary steam plunger. Each block is then simply pressed in a lever press, and after careful stove-drying is burnt in the ordinary manner.

The large sample on the table is from a quantity prepared for lining a round "Glover Tower," and the small one is, I believe, a revolver lining block.

The Combustion of Air in Coal-Gas.—A Lecture Experiment exhibited by Mr. J. T. DUNN, M.Sc.—There is nothing very new in this form of the apparatus, save that it is handier than most forms in use and does not require any reservoir of air.

It consists of an ordinary Argand chimney, mounted on a stand of convenient height. The upper end of the glass is covered by a cap of wire gauze, in the centre of which a hole of about 4 or 5 m.m. diameter has been punched. The lower end is fitted with a cork pierced with a hole in the centre, through which passes a glass tube, level with the cork beneath, and projecting 20 or 30 m.m. above its upper surface into the lamp-glass: this tube preferably ends in a wide jet of rolled platinum-foil. Two other holes in the cork, symmetrically placed on either side the centre, through which pass short tubes joined by a T-piece and india-rubber tube to the gas supply, serve to feed the apparatus with coal-gas.

The gas is turned on and lighted above the gauze. A narrow glass tube is pushed up through the open tube in the cork and through the hole in the middle of the gauze into the coal-gas flame. On gently blowing through this narrow tube (which for convenience should have a flexible india-rubber tube attached to it) the breath catches fire at the coal-gas flame, and the tube may then be gently withdrawn, when its little flame ignites the air entering the apparatus by the short open tube. The draught of the flame furnishes quite enough air to burn; and the apparatus, once lighted, will continue to act as long as the supply of coal-gas is kept up. The best air-flame is got by diminishing the gas supply to the lowest point consistent with the continued existence of the air-flame.

Groves's Apparatus for Nitrogen Determinations.—Exhibited by Mr. T. W. HOGG.—This apparatus, which is described in the *Journal of the Chemical Society* (1880, p. 500), consists of an inverted burette, graduated from the stopcock, and attached at its lower end by a flexible tube to a tube of similar dimensions open at both ends. The burette is likewise furnished, near the bottom, with a short side tube, which communicates, through a mercury valve, with the combustion-tube.

The apparatus is filled with caustic potash; the gases from the combustion-tube collect in the burette, the CO_2 being absorbed by the potash, and recession being guarded against by the mercury valve. After standing, the gas is brought to atmospheric pressure by raising or lowering the tubular reservoir, and the volume of the nitrogen read off.

Modification of Ramsbottom's Differential Gauge for Determining very slight Pressures of Gas, &c.—Exhibited by Mr. R. A. LEWIS, M.I.M.E.—This apparatus is arranged on the principle of registering the difference of pressures on the two opposite sides, A and B, of the internal diaphragm, by a column of water counterbalanced by a fluid of a density slightly less than that of water—which fluid, however, must not be miscible with water, nor be affected by it.

In this apparatus benzol has been used, tinted red for the sake of distinction.

On connecting the compartment on A side of diaphragm with the gas-pipes, while the B compartment is open to the air—a column of red fluid is forced down the inner tube, until the difference of levels of top of water C above bottom of red-fluid D is about $15\frac{1}{2}$ inches—while at the same time the small bent tube E shows a column of water of about 2.2 inches in height balanced by the gas pressure.

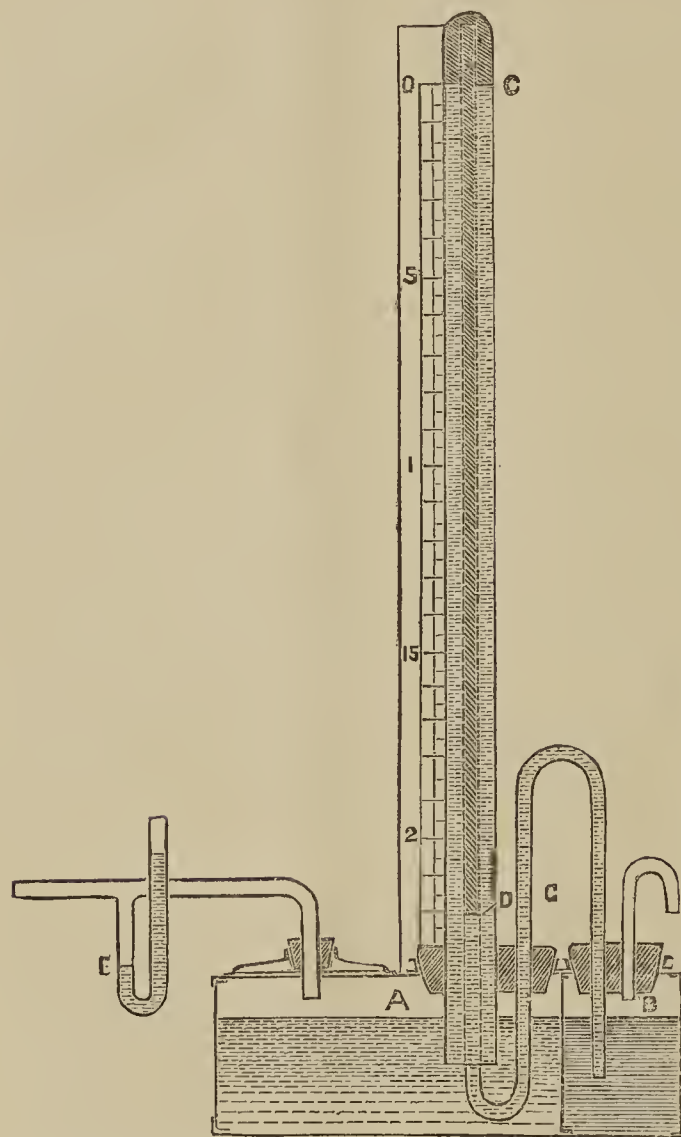
A scale affixed to the long vertical tube would thus show a length of column of red-fluid of 7 inches for each

inch of water-pressure in E. Such a length of 7 inches can easily and accurately be sub-divided into 100 parts. Where it may be desirable to have still greater accuracy, a longer range than 7 inches may be obtained by dissolving some paraffin in the benzol, thus approximating its density more to that of water.

Taking the density of water as 1, and supposing the solution of paraffin in benzol to be 0.95, then the range of this fluid would amount to 20 inches for each inch of

water-pressure, as given in the equation $\frac{1}{1-0.95} = 20$.

In applying this equation a slight correction will be necessary, owing to the raising of level in B compartment and depression in A compartment, equal to the displacement of water in small tube by the tinted fluid.



The apparatus as originally used in 1863 by Mr. T. Ramsbottom, had a glass tube of Π form, of equal diameter throughout, giving only a limited range, and some difficulty in reading off the indications.

The modification, as shown in sketch, has a long range while operating with a small amount of fluid; it is easily filled, and easily read off with a sliding scale; the application of a spring clip on the flexible tube at G makes it portable and not liable to get out of order.

Instead of the tin box, as in sketch, a couple of glass bottles may be preferred for permanent use.

Instead of water and benzol different fluids may be substituted, whose relation to one another must, however, be as stated before.

This apparatus commends itself as a portable, cheap,

accurate gauge for measuring slight pressure or suction in flues and furnaces, thus ensuring reliable control and accuracy in processes often difficult to estimate correctly on account of inconvenient differences in temperatures.

The Scrutineers then announced the result of the voting, as follows:—

Of 65 votes recorded—

52 were in favour of amalgamation.

3 against amalgamation.

7 in favour of postponing the question.

3 void from non-compliance with conditions of voting.

The proposal to amalgamate with the Society of Chemical Industry was therefore declared to be carried, and the Committee were left to take the necessary steps in arranging matters of detail.

NOTICES OF BOOKS.

A Treatise on the Metallurgy of Iron, containing Outlines of the History of Iron Manufacture, Methods of Assay, and Analyses of Iron Ores, Processes of Manufacture of Iron and Steel, &c. By H. BAUERMAN, F.G.S. Fifth Edition, revised and enlarged. London: Crosby Lockwood and Co.

THIS work, having already reached its fifth edition, may be said to have established its claim to the approval of the numerous class interested in the various branches of the iron manufacture. The present edition has been enriched with notices of the hæmatites of Spain and North Africa, and of the oolitic ores of Luxemburg and Lorraine. The modern chemical notation has been adopted, and certain recent improved methods for the determination of manganese have been added, also the modern improvements in the processes of Siemens, Bessemer, Thomas and Gilchrist.

The author, after an introductory sketch, treats successively of the general chemistry of iron, the composition and distribution of its ores geographically and geologically; of the methods preferred for the assay and analysis of the ores, the preparation or dressing prior to smelting; the processes of roasting or calcination, the fluxes employed; the blast-furnace, its accessories and the mode of working; the capacity and production of blast-furnaces and their consumption of fuel and the distribution of the heat. The varieties and composition of pig-iron are next described. The author then passes to the methods of obtaining malleable iron direct from the ore, beginning with the old Catalan process. We have next an account of the refining of grey irons, the production of wrought-iron in open fires, the puddling process, forge and mill machinery, re-heating and welding; the methods of producing steel, including the Bessemer process with its "basic" modification, first made known by Thomas and Gilchrist, and the Siemens process. The author then gives a summary of the methods for the analysis of cast metal, wrought-iron and steel, and of the mechanical properties of and tests of wrought-iron and steel.

Throughout Mr. Bauerman takes a thoroughly practical view of his subject: his descriptions are full and clear, and the illustrations—49 in number—are carefully drawn.

Practical Chemistry: Analytical Tables and Exercises for Students. By J. CAMPBELL BROWN, D.Sc. Second Edition. London J. and A. Churchill. Liverpool: A. Holden.

THIS work opens with a series of exercises on the reactions of the metals. Upon this follows a section on some of the rarer metals, to wit, uranium, cerium, tungsten, molybdenum, vanadium, and titanium. Next come systematic

instructions for the preliminary examination of simple salts and mixtures, rules for effecting the solution of unknown substances and tables for separating the metals into the usual analytical groups, the separate examination of each group, and the examination for mineral acids. There is also a general scheme for the qualitative analysis of organic compounds, whether acids, neutral substances, or bases. Lastly, follow instructions for the detection of gases—a matter which has hitherto been too much overlooked in the more elementary treatises.

The work is well arranged, and contains more valuable matter than might be expected within the compass of 52 pages.

Tables for the Qualitative Analysis of "Simple Salts" and "Easy Mixtures." By JOSEPH BARNES. Manchester: James Galt and Co. London: Simpkin, Marshall, and Co.

THE reader will notice that the words "simple salts" and "easy mixtures" are placed between inverted commas, as if they had in this case some technical meaning. The author avows on the title-page that his tables are intended "for the use of students preparing for the Government Science, Oxford and Cambridge Local, &c., Examinations." We have so often expressed our regret at the circumstances

tions. By their use the operator can see at a glance, from the weight of the precipitate obtained, the percentage of the substance to be determined in the sample. Not all the bodies commonly requiring to be estimated are included in the author's plan. The tables are applicable either to grain weights or to the metric system.

To many chemists the book will prove a great convenience.

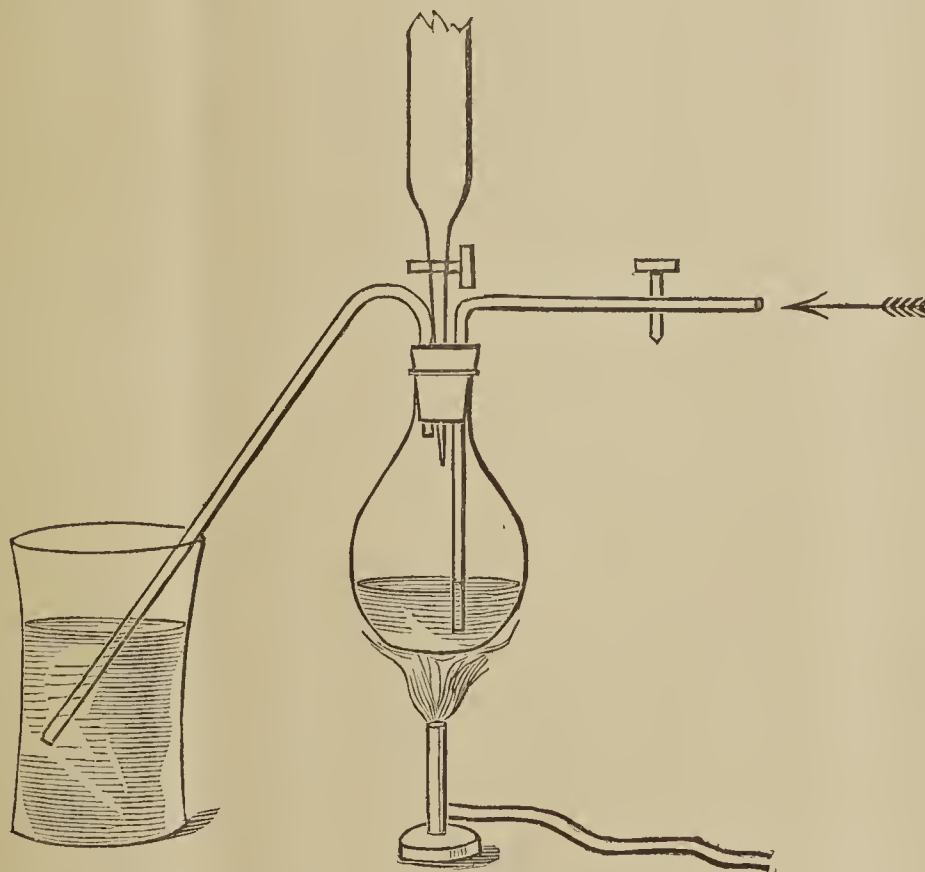
CORRESPONDENCE.

AMMONIO-CUPRIC METHOD FOR THE QUANTITATIVE ESTIMATION OF GRAPE-SUGAR.

To the Editor of the Chemical News.

SIR,—Having had occasion lately to employ Dr. Pavy's ammonio-cupric method for the quantitative estimation of grape-sugar, I have found much advantage to accrue from the following addition to that excellent process:—

After the complete reduction of the cupric solution by boiling with the sugar, *air* is made to bubble through the decolourised liquid in the flask, when the blue colour of



which make such examinational treatises necessary, and our preference for books written for the use of students who wish to acquire a thorough knowledge of the subject, that no more need be said.

Mr. Barnes addresses himself principally to students who are able to devote only an hour or two weekly to laboratory work. We find nothing objectionable in his treatise, but, on the other hand, we scarcely see any marked advantage which it possesses over other manuals, &c., of a similar nature.

Chemical Percentage Tables and Laboratory Calculations. By C. H. RIDSDALE, F.C.S. Manchester: Emmott.

ONE object of the tables before us is to save the time and trouble now often consumed in the laboratory in calcula-

cupric copper at once re-appears, and after passing $1\frac{1}{2}$ litres of air in about *fifteen minutes* through the ammoniacal solution, the copper is found to be completely re-oxidised, and is ready for a second determination with the *same liquid as before*. Care is taken to add a considerable excess of *ammonia solution* in the first instance, to avoid precipitation of Cu_2O by prolonged boiling in the double determination.

The annexed figure exhibits the apparatus employed. The most convenient arrangement for forcing the air through the copper solution I have found to be a "Dancer's Aspirator."—I am, &c.,

G. STILLINGFLEET JOHNSON.

Chemical Laboratory,
King's College, W.C.
January 17, 1883.

SCOTCH AMMONIACAL LIQUORS.

To the Editor of the Chemical News.

SIR,—It appears to have escaped the notice of many buyers that since the gas managers have so much added to their washing apparatus the quantity of liquor has greatly increased (in some cases over 50 per cent). The quality, however, has vastly deteriorated, liquor 5 Tw. at 60° now containing only 1.50 to 1.55 per cent of ammonia, or 7 ounces, instead of 2.16 per cent, or 10 ounces, as formerly. The extra washing absorbs H_2S and CO_2 , and so the hydrometer is kept up at 5 Tw. as before. The sales are usually made per 100 gallons tar and water *mixed*, and there being no increase, but rather a diminution, in the quantity of the former, the increase in the proportion and quality of the liquor tells very heavily against the buyer. —I am, &c.,

January 25, 1883.

NH₃.

BLOWPIPE ANALYSIS.

To the Editor of the Chemical News.

SIR,—In reply to Prof. Cornwall's complaint in the CHEMICAL NEWS, vol. xlvii., p. 47, of misquotation on my part, I would ask him if, in the case of anyone studying his, or another "Manual," for the purpose of learning a scientific subject, the words "student" and "beginner" are not synonymous, or at all events convertible, terms? When a man has mastered the delicate and difficult operations recommended by Prof. Cornwall in the qualitative analysis of *Smaltite*, he certainly can no longer be called a "beginner;" but then there would be no less impropriety in terming such a master of the art a "student," so that I really fail to see how I have "so completely misquoted this passage." With regard to my further alleged inaccuracy in not completing "the passage"—which is a very long one—in my quotation, the Professor will doubtless by this time see that he has himself committed the same heinous crime in his professedly accurate quotation, which abruptly closes with "if, &c.," the part he has omitted being decidedly favourable to my view, so that after all we are "in the same boat" as to "misquotation."

May I now briefly complain in my turn of the system apparently followed at the John C. Green School of Science, N. J., where Prof. Cornwall admits that, in the preparation of what is intended as (and no doubt otherwise is) an exhaustive work on blowpipe analysis, the author "was until yesterday unaware of the existence" of a work on the same subject, in the same language, which has been in print nearly three years? I presume he has not yet heard of the existence of an English translation of Landauer's excellent little "Manual" published in 1879, nor of the publication in German, at Berlin, in August, 1881, of its second edition? Authors of scientific books in other parts of the world are supposed to collect and digest all the information they possibly can on the subject before publication.

If Prof. Cornwall has never heard of me before, I can only say that I still possess a letter from his publishers, Van Nostrand and Co. (who, by the way, informed my publishers, Trübner and Co., that they would neither keep nor sell my books), warmly thanking me for having written some letters, published in the *London Mining Journal*, in reprobation of a piracy in England of Prof. Cornwall's admirable translation of "Plattner" in 1875: an interference which did me serious injury at the time, and which, being thus thanklessly repaid, I now most heartily regret. —I am, &c.,

W. A. Ross.

Acton, W., January 26, 1883.

Methods and Researches of Physical Chemistry.

—O. Pettersson has published two extensive memoirs, in which he treats of the determination of the thermic constants at their melting-points.—*Zeitschr. f. Anal. Chem.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 3, 1882.

Notes on Kissling's Paper on the Determination of Nicotine in Tobacco.—G. Dragendorff.—The writer points out that the method for the determination of nicotine, which Kissling attributes to him, is due to Mayer.

An Apparatus for Furnishing Sulphuretted Hydrogen.—Clemens Winkler.—The apparatus cannot be intelligibly described without the accompanying figure.

Method for the Analysis of Mustard.—A. R. Leeds and Edgar Everhart.—The authors determine moisture and ash as usual. The oil is extracted with ether as follows: A weighed quantity of mustard is dried at 105°, and carefully introduced into a folded filter, which is then placed in a funnel with straight sides. The tube of the funnel is then connected by means of a well-fitting cork with a weighed flask, partly filled with ether. The filter is also connected with an ascending condenser. If the ether is gently warmed this simple extraction-apparatus is brought into action. When all the oil is extracted the apparatus is disconnected, the ether distilled off, the flask and its contents dried at 100°, and weighed. The increase of weight is oil. The residual ether is removed from the mustard by evaporation, and a flask filled with a mixture of equal parts of alcohol and ether is connected to the funnel in place of the one with ether. The extraction-apparatus is again set in action. The dilute alcohol dissolves both the sinapine sulphocyanide and the potassium myronate, but coagulates the myrosine, and leaves it and the cellulose undissolved. After the soluble matter has been extracted the contents of the flask are rinsed into a weighed platinum capsule, evaporated at 105°, and weighed. From the residual potassium sulphate the potassium myronate is calculated, and the sinapine sulphocyanide is found from the difference. The residue in the filter is freed from alcohol by evaporation, and the myrosine and cellulose are treated with a solution of soda at $\frac{1}{2}$ per cent. The solution containing the myrosine is decanted through a weighed filter, and the residue is again treated in the same manner; all the myrosine is thus obtained in solution. The cellulose left on the filter is dried, weighed, ignited, and the ashes weighed and deducted. The solution containing the myrosine is approximately neutralised with hydrochloric acid, about 50 c.c. of Ritt-hausen's solution of copper sulphate added, then exactly neutralised with dilute soda lye, and the heavy green precipitate containing the copper myrosine compound is allowed to settle. It is collected on a weighed filter, dried at 110°, and weighed. It is then incinerated, and the ash deducted. The total weight of the precipitate, after deducting the ash, gives the myrosine present. In case of mustard adulterated with starch or flour, after extracting the oil with ether and the sinapine sulphocyanide and potassium myronate with alcohol, the residue may be treated with diastase or dilute acid under pressure in order to convert the starch into glucose, which is then determined as usual. Starch is absolutely insoluble in dilute alcohol.

Determination of the Melting-Point of Fats.—Dr. Kretschmer.—Already noticed.

Separation of Barium from Strontium and Calcium by Neutral Potassium Chromate.—J. Meschezerski.—This method, devised by Smith, and since examined by Smith, Fleischer-Kämmerer, and Frerichs, is inconvenient. Strontium chromate is very sparingly soluble in water and acetic acid. One part of the salt requires 840 parts water at 16° for solution. In presence of excess of acetic acid

neutral chromate gives a precipitate even in dilute solutions of strontium salts on standing, which is more abundant at the boiling-heat. One part of barium chromate dissolves in 23,000 parts of boiling water. In acetic acid it is more soluble. Barium chromate has a great tendency to carry down other salts along with it.

Report on General Methods, Analytical Operations, Apparatus, and Reagents.—W. Fresenius.

Self-acting Washing Apparatus.—M. Andreef and L. Cohn.—The former allows the washing water to flow out of a large receiver through a narrow pipe upon the funnel containing the precipitate. When it is full to a certain point the flow of water is interrupted. This is effected in one form of the apparatus by means of an electro-magnet, and in another form on the principle of the balance. The apparatus of Cohn is designed for washing out precipitates on folded filters, and depends on the principle of the extraction-apparatus, as often proposed for determinations of fat.

New Form of Washing-Bottle.—A. E. Johnson.—From the *CHEMICAL NEWS*.

Asbestos Plugs for Combustion Tubes.—J. Fleming White.—From the *American Chemical Journal*.

Capsules and Funnels of Papier-Maché.—These vessels bear heating on the water-bath, and are little affected by fatty and mineral oils, dilute acids, solutions of sodium carbonate, and other salts. Ether and alcohol at 96° soften the varnish in course of time. Caustic alkalies, even if very dilute, have an energetic action.

Spirit Lamp.—G. Munder.—The author recommends the common petroleum lamps as well adapted for burning spirit. He recommends the insertion of a piece of brass wire gauze in the inner channel to prevent the flame from striking down.

Universal Gas-burner.—P. Gebhardt.—This arrangement is said to be equally well adapted for a common Bunsen burner and for a blast.

Blowpipe with Constant Blast.—A. Koppe.—Differs little from the forms proposed by Dupré and J. Rabs. J. J. Hesz proposes a blowpipe, the point of which is surrounded by a double jacket. A side tube leads into the outer space, from which air is carried along.

Occurrence of Arsenic and Vanadium in Commercial Soda.—E. Donath.—The presence of arsenic in soda made with acid from pyrites is well known. The proportion of vanadic acid in some sodas is said to be 0.014 per cent. This impurity may give rise to errors in analyses.

Contamination of Litharge and Lead Acetate with Calcium Sulphate.—M. Schlagdenhauffen.—Three samples of litharge contained 0.35, 0.80, and 1.15 per cent of calcium sulphate, and in different samples of lead acetate the impurity ranged up to 4.44 per cent.

Chemical Analysis of Inorganic Bodies.—E. Hintz.

Spectrum of Oxygen.—A. Paalzow and H. W. Vogel.—The details are not given.

Determination of Potassium.—F. Mohr.—The process is based on the volumetric determination of chlorine in the precipitate of platinum potassium chloride. He fuses the double chloride with double its weight of sodium oxalate, extracts the melt with water, and determines the chlorine volumetrically in the solution. M. L. L. de Koninck proposes a modification of this process, which has been noticed in the *CHEMICAL NEWS*.

Separation and Determination of Potassium as Potassium Platinum Chloride.—David Lindo.—From the *CHEMICAL NEWS*.

Method for Determining Potassa and Soda in Potash.—H. Hager.—The process assumes that no other substance but the alkaline carbonates is present. The author mixes the carbonates with 4 parts of picric acid, moistens with water, heats, and evaporates on the water-

bath. The dry mass is ground to powder, repeatedly extracted with absolute alcohol, and washed with alcohol of the same strength till no residue appears on evaporating the washings upon a slip of glass. The potassium picrate thus obtained is dried at 100°, and weighed. Its weight divided by 3.8 gives the corresponding quantity of anhydrous potassium carbonate. To determine the soda in the alcoholic filtrate the alcohol is distilled off, the residue is taken up in a little water, and evaporated to dryness. The sodium picrate may be freed from excess of picric acid by extraction with benzol. The weight of the sodium picrate dried at 100° and divided by 4.736 gives the corresponding anhydrous sodium carbonate.

Separation of Zinc from Cadmium and Determination of the Latter.—M. Kupfferschläger.—From the *Bulletin de la Soc. Chimique*.

Method of Determining Precipitated Copper Sulphide.—From the *Journal für Prakt. Chemie*.

Chemical Analysis of Organic Bodies (1. Qualitative Detection of Organic Bodies).

Recognition of Primary, Secondary, and Tertiary Alcohols and Alcohol Radicals.—Meyer and Locher have previously given very characteristic colour reactions (*Zeit. Anal. Chemie*, xiv., p. 371). H. Gutknecht has made experiments to ascertain to what members of the alcohol series these reactions may be observed. He finds that the reaction for secondary alcohols occur only in propylic, butylic, and amylic alcohol; among the primary alcohols it appears in octylic alcohols, and probably even in higher members of the series.

Atropine, Daturine, Duboisine, Hyoscyamine, and Hyoscine.—A. Ladenburg.—From the *Berichte der Deutsch. Chem. Gesellschaft*.

Quantitative Determination of Organic Bodies (a. Elementary).

A Modification of Varrentrapp and Will's Method of Determining Nitrogen.—J. Ruffe.—From the *Journal of the Chemical Society*.

Determination of Tannin.—A. Lehmann.—A quantity of the sample, supposed to contain 0.2 to 0.6 grm., is repeatedly extracted with fresh quantities of hot water; when cold the mixed extracts are made up to a fixed volume (100 or 200 c.c.), and filtered through a dry filter. To 10 or 20 c.c. of this solution, mixed with an equal volume of a cold saturated solution of sal-ammoniac, solution of gelatin is run in from a burette divided into tenths of a c.c. as long as a precipitate is formed. The solution is prepared by dissolving 1 grm. gelatin in 100 c.c. of a cold saturated solution of sal-ammoniac. If this precaution is observed the precipitate always clots together and settles well. To detect the end of the reaction a few drops of the supernatant fluid is drawn through a small filter into a glass tube. If the end is reached the liquid is rendered turbid neither by a drop of tannin solution nor by a drop of gelatin solution.

Picrates of the Alkaloids.—H. Hager.—The author recommends this form as convenient for weighing, especially for the Cinchona alkaloids.

Special Analytical Methods.—F. Hofmeister and W. Lenz.

Sanitary Examination of the Air in Closed Spaces.—To determine the dryness of the air Niedner makes use of a sensitive balance beam to one of whose arms is fixed a frame of 1000 square centimetres surface covered with the finest linen. It is moistened with water, weighed, and the author observes how much water evaporates in a given time. Or the seconds are counted which are required for the evaporation of a given quantity of water.

Determination of Carbonic Acid in Expired Air.—W. Marcet.—From the *Journal of the Chemical Society*.

The Aræometric Method for Determining the Fat in Milk.—M. Soxhlet.—Soxhlet's method is applicable only to milks of 2.07 to 5.12 per cent fat. For skim-

milks it is often inapplicable. If skim-milk is to be examined, in this method 200 c.c. of the sample are mixed with 0.4 to 0.5 c.c. soap-lye.

Water Analysis: Detection of Lead and Nitric Acid.—From the *Analyst* and the *CHEMICAL NEWS*.

Analysis of Wine.—J. Piccard.—The author finds that the method of Berthelot and Fleurien for determining tartar and free tartaric acid is not always satisfactory. It is preferable to mix 10 c.c. of wine with some crystals of potassium acetate, 2 or 3 drops of acetic acid, 25 c.c. alcohol, the same volume of ether, and a pinch of sand. The whole is placed for seventy-two hours in an ice-closet, and is shaken from time to time, filtered, and the deposit of tartar is determined by known methods.

Determination of Succinic Acid.—R. Kayser.—The author evaporates 200 c.c. down to one-half, adds lime-water until the reaction is alkaline, and filters, which removes the tartaric acid, and especially the phosphoric acid. Excess of lime is removed by a current of carbonic acid, the liquid is boiled, and in the neutral filtrate the succinic acid is thrown down by ferric chloride as basic ferric succinate, washed with alcohol at 70 per cent, dried, ignited, and the residue (iron oxide) weighed.

Determination of Malic Acid.—R. Kayser.—The author modifies Nessler's process as follows: 100 c.c. of wine are evaporated down to one-half, supersaturated with sodium carbonate, mixed with 10 c.c. of concentrated solution of barium chloride in a graduated agitation cylinder holding 100 c.c., filled up with water to 100 c.c., well shaken, and let stand for twelve to twenty-four hours. Only the malic and acetic acids of the wine remain in solution. The latter is filtered, an aliquot portion of the filtrate is mixed with hydrochloric acid in excess, and evaporated to dryness in the water-bath. Free hydrochloric acid and acetic acid are volatilised, and only neutral chlorides and free malic acid remain, the quantity of which is determined acidimetrically. If the wine is strongly coloured it is first decolourised with animal charcoal.

Acetic Acid.—R. Kayser.—The author's method cannot be described without the accompanying figure.

Potassa in Wines.—R. Kayser.—The author dissolves 0.7 gm. soda crystals and 2.0 grms. tartaric acid in about 100 c.c. wine, adds 150 c.c. alcohol of 92 to 94 per cent, and lets it stand twenty-four hours. The separated tartar is collected on a small filter, washed with so much alcohol at 50 per cent that the filtrate makes up 260 c.c.; the tartar together with the filter is returned to the beaker in which the precipitation takes place, dissolves it in hot water, the solution is made up to 200 c.c., and 50 c.c. are titrated with decinormal soda. According to the author's experiments on the precipitation of the tartar, about 0.004 potassa remains in solution.

Sulphuric Acid in Pure Wines.—E. List.—Pure German white wines may contain as much as 0.08986 gm. per litre sulphuric acid (SO_3). In Madeira there may be 0.11920 sulphuric acid, though the ash retains its strong alkaline reaction,—a characteristic of genuine wines. According to B. Haas, V. Wartha's method for detecting and determining sulphurous acid in wines is deceptive, since wines of undoubted purity may yield a distillate having the reactions which Wartha pronounces characteristic of sulphurous acid, especially the turbidity with silver nitrate, disappearing on the addition of nitric acid. According to L. Liebermann the substance concerned is identical with formic acid. Even acetic acid precipitates silver nitrate in a strongly alcoholic liquid. Haas determines sulphurous acid in wine by putting 100 c.c. of the sample in a flask holding 400 c.c., and distilling in a current of carbonic acid down to one-half. As a receiver he uses a Pélégot's tube (the bulbs of which hold about 100 c.c.) containing 30 to 50 c.c. solution of iodine. Before beginning the operation the apparatus is filled with carbonic acid. The Pélégot tube is kept immersed

in cold water and the escape tube for steam may also be refrigerated. When the distillation is at an end the solution of iodine is rinsed into a beaker, heated with a little hydrochloric acid, and the sulphuric acid formed is determined in the usual manner.

Colouring-Matter of Wine.—A. Dupré contests the alleged identity of the colouring-matters of the grape and of the bilberry (*Vaccinium myrtillus*), since the latter dialyses easily, but the former with difficulty. For the detection of logwood colour in wine, A. Pizzi shakes up 20 c.c. wine with 2 grms. manganese peroxide, and filters. The filtrate is reduced with zinc and hydrochloric acid, thus forming hæmatoxyline, which is detected by the usual tests. If the liquid, on treatment with a neutral solution of ferrous sulphate, turns deep violet, hæmatoxyline is present. A reddish brown colour indicates brasiline.

Detection of Various Colours in Wine.—H. Macagno.—From the *CHEMICAL NEWS*.

Examination of Flour.—G. Steenbuch.—In order to isolate the fragments of tissue which are more characteristic than the starch granules, the author stirs up 10 grms. of the flour with 30 to 40 grms. distilled water to a uniform paste, and then adds 150 grms. boiling distilled water. The whole is let cool down to 50° to 60°, and 30 c.c. of a filtered extract of malt are added, made by macerating for an hour 20 grms. ground malt with 200 grms. cold water. The mixture is heated for ten minutes to 55° to 60° in the water-bath, then poured into a larger quantity of water, repeatedly decanted, pouring off the liquid as far as possible from the sediment, and digesting the latter at 40° to 50° with soda-lye at 1 per cent., thus dissolving the amorphous albumenoid matters. The liquid is again poured into a larger quantity of water, and deposits the elements of the tissues in a form well suited for microscopic examination. This process is well suited for other powders containing starch, such as cinnamon, and cocoa, which must be previously freed from fat.

Specific Gravity of Butter.—A. W. Blyth.—From the *Analyst*.

Execution of Berthier's Method of Determining the Heating Power of Fuel.—C. L. Munroe, instead of a crucible uses a non-galvanised iron-tube, 1 inch in diameter and a foot long. One end is closed with a well-fitting screw-stopper, and to the other end is screwed a $\frac{1}{2}$ -inch tube 3 feet long. 1 gm. of the coal in question is mixed with 40 grms. of litharge, put in the tube, and covered with a stratum of unmixed litharge. It is then placed in the furnace of a steam-boiler, so that the open end projects out about 6 inches, and is heated till no more pressure is felt on closing the open end with the finger. The whole process lasts about ten minutes. The tube is taken out, and set with its closed end downwards so that the melted lead may sink to the bottom. The screw is then opened, the lead is run out, and its weight gives a measurement for the reducing power of the coal.

Analysis of Iron Ores containing Phosphoric and Titanic Acids.—T. M. Drown and P. W. Shimer.—This process is not described.

Determination of Basic Slags and Oxides in Wrought-iron.—W. Bettel.—From the *CHEMICAL NEWS*.

Volumetric Determination of Sodium Sulphate in Salt-cake.—A. Bertrand.—From the *Moniteur Scientifique*.

Determination of Sulphur in Sulphides, Coal, and Coke.—T. M. Drown.—From the *CHEMICAL NEWS*.

Table of the Specific Gravities of the Solutions of Sulphur in Carbon Disulphide.—H. Macagno.—From the *CHEMICAL NEWS*.

Analysis of Sulphuric Anhydride and Fuming Sulphuric Acid.—O. Clar and J. Gaier.—The authors weigh the fuming acid in thin glass bulbs of 20 m.m. in diameter, provided with two long capillary points opposite to each other. The bulbs are half-filled with the acid by suction, and are then sealed up at both ends. After

weighing, a point is broken off under water. The anhydride is weighed in small glass bottles 58 m.m. high, 17 m.m. wide, with high ground stoppers, enlarged conically above, and with a small aperture in its summit closed with a minute glass plug. The interior of the stopper is filled with glass wool, slightly moistened. The bottle when charged and weighed is allowed to glide in an inverted position into a 2 litre flask held in a sloping position, and containing about 500 c.c. water at 50° to 60°. After mixture has taken place through the small aperture in the stopper, the liquid is made up to 1 litre, and a portion of 100 c.c. is titrated with 5-normal soda.

Examination of Chamber and Tower Gases.—G. A. Davis.—From the CHEMICAL NEWS.

MISCELLANEOUS.

Popular Science.—The following is from a recent number of the *Ashton Reporter*:—

"WATER CARRIED AS GAS.—M. Pasteur, a nephew of the celebrated chemist of that name, has recently adapted an old discovery to great practical use. It is a well-known fact that the crossing of the great African Desert is accomplished by means of caravans composed of camels, horses, &c., the water for which has to be transported on the back of the consumer. This lessens to a great degree their freighting capacity. M. Pasteur has established suitable works at the numerous termini of the routes for separating the water into oxygen and hydrogen. As the latter is sixteen times lighter than the former, and is the gas used in balloons, it carries the oxygen and a considerable part of the camel, besides furnishing light on dark nights. He unites the gases by the simple means of explosion when desired for use. The French Government has created M. Pasteur a commander of the Legion of Honour for his great adaptation."

Society of Arts.—The following are the premiums offered by the Society of Arts for the 129th Session of the Society (1882-3):—John Stock Prize.—A Society's Gold Medal, or £20, for the best design, from a poem, or from history, or from the Scriptures, prepared with a view to Mural Decoration. Benjamin Shaw Prize.—1. A Society's Gold Medal, or £20, for the best plan for "obviating or diminishing risk to life in the operations of coal-mining." 2. A Society's Gold Medal, or £20, for the best plan for "obviating or diminishing risk to life in the manufacture, storage, and transport of explosives." The Council of the Society leave it to the competitors to bring the plans under their notice in any way they may think proper, whether by model, written description, or otherwise. Howard Prize.—A prize of £100, for the best Essay on the Utilization of Electricity for Motive Power. Preference is to be given to that Essay which, besides setting forth the theory of the subject, contains records with detailed results of actual working of experiment. The Society reserves the right of publishing the prize essay. Fothergill Prize.—A Society's Gold Medal, or £20, for the best invention having for its object the Prevention or Extinction of Fires in Theatres, or other Places of Public Amusement. Mulready Prize.—A Society's Gold Medal "To that Student in a School of Art in the United Kingdom who exhibits the best Drawing from the nude figure, executed in black and red chalk, in the manner so successfully practised by Mulready." Designs, plans, models, essays, descriptions, inventions, &c., intended to compete for any of the above Prizes, must be sent in on or before the 31st October, 1883, to the Secretary of the Society of Arts, John Street, Adelphi, London. The Council of the Society reserve the right of withholding any or all of the above Prizes, or of awarding others of lesser value in their stead, in any case in which there is nothing in their opinion deserving the award, or sufficiently complying with the conditions, sent in for competition.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Spanish White.—What is the chemical name for a substance known as "Spanish white," and where can it be obtained?—G. P.

MEETINGS FOR THE WEEK.

- MONDAY, Feb. 5.—London Institution, 5.
Medical, 8.30.
Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field, F.C.S.
Society of Chemical Industry, 8. "On the Chemistry and Methods of Examining Fixed Oils," by A. H. Allen, F.C.S. "On Chamber Exit Gas Testing," by Mr. W. Pringle.
Royal Institution, 5. General Monthly Meeting.
- TUESDAY, 6th.—Royal Institution, 3. "Primæval Ancestors of Existing Vegetation," by Professor W. C. Williamson.
Institution of Civil Engineers, 8.
Pathological, 8.30.
Society of Arts, 8. "Social Conditions and Prospects in Madagascar," by the Rev. J. Peill.
- WEDNESDAY, 7th.—Society of Arts, 8. "The Modern Lathe," by Mr. J. H. Evans.
Geological, 8.
Pharmaceutical, 8.
- THURSDAY, 8th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.
London Institution, 7.
Royal, 4.30.
Royal Society Club, 6.30.
- FRIDAY, 9th.—Royal Institution, 8. "Emerson and His Views of Nature," by Mr. M. D. Conway, at 9.
Astronomical, 3. Anniversary.
Quekett Club, 8.
- SATURDAY, 10th.—Royal Institution, 3. "The Siege and Capture of Delhi," by Mr. R. Bosworth Smith.
Physical, 3. Annual General Meeting. "On the Graphic Representation of the Duty and Efficiency of Electric Motors," by Prof. Silvanus P. Thompson.

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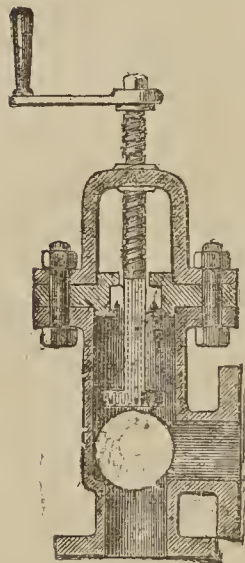
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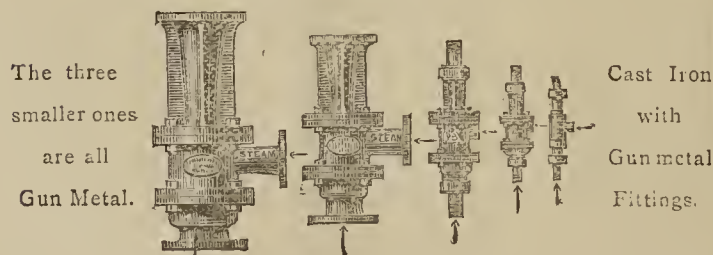
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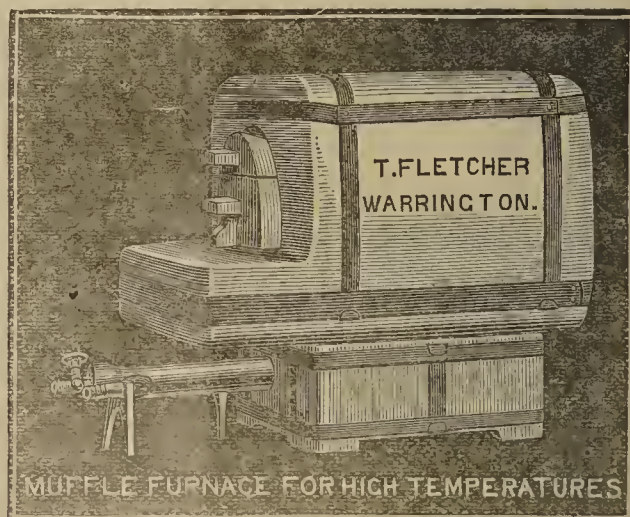
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1211.

NOTE ON THE ABSORPTION SPECTRUM OF IODINE IN SOLUTION IN CARBON DISULPHIDE.*

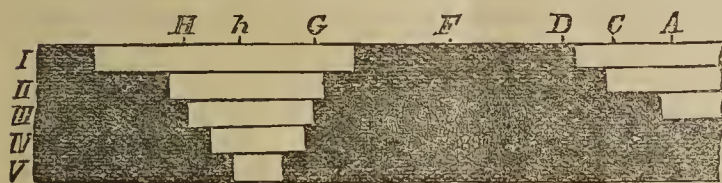
By Captain ABNEY, R.E., F.R.S., and
Lieut.-Colonel FESTING, R.E.

IN 1876, Sir John Conroy (*Proc. Roy. Soc.*, vol. xxv., p. 46), described the absorption spectrum of a solution of iodine in carbon disulphide. He, however, solely regarded the visible spectrum from near B to above G, about wave-length 4000.

Our attention was recently directed to the absorption of this substance, and we have determined photographically the spectra for different thicknesses and strengths of the solution.

Our inquiries into the behaviour of carbon disulphide had shown us that it, as well as iodine, was transparent for rays of very low refrangibility, as was first shown by Prof. Tyndall. We are not aware, however, that any investigations into the absorption at the more refrangible end of the spectrum have been published. An idea seems to be prevalent that the absorption commences in the green, and gradually extends, as the thickness or density of the solution is increased, in both directions until finally all the visible rays are extinguished, leaving the invisible rays at both ends unabsorbed.

Though one of us employed the solution before to cut off the visible portion of the spectrum (*Phil. Trans.*, part ii., 1880, p. 664) in diffraction photography of the lower part of the spectrum, the use of it was abandoned owing to the opinion that was expressed that instead of the infra-red being photographed, the ultra-violet and violet of the spectrum of the next order might be that which was really impressed. Our recent experiments, however, show that no fear need have been entertained on this account, as the annexed diagram will show.†



The following thicknesses and strengths of solution were employed, being placed before the slit of the photographic spectroscopie:—

Iodine in CS ₂ .		Thickness.
No. I....	4 per cent equivalent to	2 millims.
„ II....	8 „ „	2 „
„ III....	12 „ „	2 „
„ IV....	16 „ „	2 „
„ V....	32 „ „	2 „

The source of light was usually the crater of the positive pole of the electric lamp, though in two instances we were favoured with a glimpse of sunshine, which enabled us to confirm what we had before obtained with the less brilliant source of light. For Nos. I., II., and III., photographs were taken, which gave the red and infra-red spectrum, as well as the more refrangible end. With every number ordinary gelatin plates of great sensitiveness were

employed as a check on the collodion plates. To the eye the red, in each case, extends a trifle more towards D than in the photograph.

An attempt was made to produce the same range of photographic action in the spectrum of the thicker solutions as in the less dense, by increasing the time of exposure. The result, however, was abortive, and hence we may conclude that when any visible ray is quenched to sight by a solution of particular density, it also ceases to be photographically active.

The last ray to disappear in the blue lies somewhere close to h, and it will be seen that the ultra-violet rays are absorbed before the absorption touches the violet. By using a still denser solution than No. V., we are able to entirely quench the blue, both visually and photographically, while the extreme red was still visible, and the photograph taken showed no signs of absorption of the infra-red rays.

In conclusion we would remark, that by the use of this solution in a rock-salt cell and a grating, the infra-red spectrum from λ 7600 to λ 15,200 may be photographed without the instrumental separation of the different orders of spectra; and the conditions of our climate are such that the atmospheric absorption usually, if not always, prevents a study of the solar spectrum below the greater wave-length above-named.

PRELIMINARY NOTE ON A THEORY OF MAGNETISM BASED UPON NEW EXPERIMENTAL RESEARCHES.*

By Prof. D. E. HUGHES, F.R.S.

IN the year 1879† I communicated to the Royal Society a paper "On an Induction Currents Balance and Experimental Researches made therewith." I continued my researches into the molecular construction of metallic bodies, and communicated the results then obtained in three separate papers‡ bearing upon molecular magnetism.

To investigate the molecular construction of magnets required again special forms of apparatus, and I have since been engaged upon these, and the researches which they have enabled me to follow.

From numerous researches I have gradually formed a theory of magnetism entirely based upon experimental results, and these have led me to the following conclusions:—

1. That each molecule of a piece of iron, steel, or other magnetic metal is a separate and independent magnet, having its two poles and distribution of magnetic polarity exactly the same as its total evident magnetism when noticed upon a steel bar-magnet.

2. That each molecule, or its polarity, can be rotated in either direction upon its axis by torsion, stress, or by physical forces such as magnetism and electricity.

3. That the inherent polarity or magnetism of each molecule is a constant quantity like gravity; that it can neither be augmented nor destroyed.

4. That when we have external neutrality, or no apparent magnetism, the molecules, or their polarities, arrange themselves so as to satisfy their mutual attraction by the shortest path, and thus form a complete closed circuit of attraction.

5. That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically in a given direction, producing a north pole if rotated in this direction as regards the piece of steel, or a south pole if rotated in the opposite direction. Also, that in evident magnetism, we have still a symmetrical arrangement, but

* A Paper read before the Royal Society, Jan. 25, 1883.

† This diagram represents the absorption of the continuous spectrum. The bright bands in the electric light above K had power to penetrate the solutions II. and III.

* A Paper read before the Royal Society, Feb. 1, 1883.

† *Proc. Roy. Soc.*, vol. xxix., p. 56, 1879.

‡ *Proc. Roy. Soc.*, vol. xxxi., p. 525; vol. xxxii., pp. 25, 213, 1881.

one whose circles of attraction are not completed except through an external armature joining both poles.

The experimental evidences of the above theory are extremely numerous, and appear so conclusive, that I have ventured upon formulating the results in the above theory.

I hope in a few weeks to bring before the Royal Society the experimental evidence which has led me to the conclusions I have named; conclusions which have not been arrived at hastily, but from a long series of research upon the molecular construction of magnetism now extending over several years.

ON THE EVAPORATION OF LIQUIDS, AND IN PARTICULAR OF MERCURY, IN A SPACE FREE FROM AIR.

By H. HERTZ.

If a liquid evaporates in a gas the pressure of which is greater than the pressure of the saturated vapour of the liquid, the vapour in the neighbourhood of the surface is always very close upon the state of saturation, and the speed at which evaporation takes place is primarily dependent upon the speed with which the arising vapour is removed. The removal of the vapour, at least in the strata near the surface, takes place in the way of diffusion. Proceeding from this view, the evaporation of a liquid in a gas has often been taken into consideration. But hitherto it appears no attention has been given to the conditions which regulate the speed of evaporation in a space which, in addition to the liquid, contains merely its own vapour. In the first place, evaporation in a space free from air is conditioned by the speed with which the vapour formed can escape, in as far as such escape, under certain circumstances, is much delayed by internal friction; this condition is evidently very unessential. For if we conceive the evaporation as taking place between the plane and parallel liquid surfaces, it might proceed with an infinite speed. The rate at which heat is conveyed to the surface of the liquid may be given as a condition of the evaporation. In the stationary condition exactly such a quantity of liquid will evaporate that its latent heat is equal to the heat conveyed to it; but this explanation is imperfect, since with an equal right the supply of heat might be conversely regarded as determined by the evaporation. Both depend on the temperature of the external surface, and this again depends on the proportion between the heat possibly supplied by conduction and the heat possibly lost by evaporation. The case may be twofold:—Either, *a*, the evaporation has no other limit than that fixed by the supply of heat and from a given surface; an unlimited quantity of liquid may evaporate in a unit of time, if the supply of heat is sufficient without the temperature, the density and the pressure of the escaping vapour being notably different from those of saturated vapour. All liquid surfaces in the same space must assume an equal temperature, and this temperature, as well as the quantities of liquid evaporating, are conditioned by the relation of the possible supply of heat to the different surfaces. Or, *b*, from a liquid surface at a given temperature only a limited quantity of liquid can evaporate. Then, in the same space there can exist surfaces of different temperatures, and the pressure and density of the vapour passing off must be different from the pressure and density of the saturated vapour of at least one of these surfaces of a finite quantity. The rate of evaporation depends, beside a series of secondary conditions, also, in the first place, on the nature of the liquid, a specific power of evaporation existing for every liquid.

It will be seen that the alternative *a* can be regarded as an extreme case of *b*, and that without hypothesis or de-

cisive experiment only the latter, more general, view can be accepted as correct. It will appear below that the former alternative may be regarded as extremely improbable.

In order to obtain an experimental decision between the two above-mentioned alternatives, if possible by the exact measurement of the evaporative power of any liquid under different circumstances, the author has instituted a series of experiments on evaporation in space free from air, which, however, have only partially effected their object. They are nevertheless described, as they are calculated to show more clearly the problem in question, and perhaps to point a way to better methods. To the description is appended a series of considerations which are to justify the fundamental conceptions, and to fix limits at least for the values to be dealt with.

In his experiments the author proceeded from the assumption that the rate of evaporation from a surface must be determined by the temperature of the surface, and the pressure exerted upon it by the escaping vapour. In the course of the investigation doubts occurred, not whether these two magnitudes were essential, but whether they were sufficient conditions for the quantity of the liquid evaporated. This doubt was found to be baseless. The immediate problem was therefore to find for any liquid the values of the temperature (*t*) of a surface, of the pressure (*P*) upon it, and the depth (*h*) of a stratum of liquid evaporating in a unit of time. The difficulty of this apparently simple problem lies in the determination of *t* and *P*. If the evaporation is even, but moderate, very considerable quantities of heat are needed to keep it up. Hence the temperature increases rapidly from the surface downwards, and if a thermometer is plunged but a little way into the liquid it no longer indicates the true temperature of the surface. The experiments show, further, in case of a moderate evaporation, the deviation of the pressure from that of saturated vapour, and, as this deviation is the essential point, it follows that both pressures must be measured very accurately. Lastly, it must be considered that in these experiments the liquids must be in their interior in a superheated state: as a "bumping" ebullition would render the experiments impossible, we are restricted to a very narrow margin both in temperature and pressure.

(The description of the author's experiments cannot be reproduced without the aid of the three accompanying figures.)

The total result of the experiments is but limited; they show that the pressure of the escaping vapour upon the liquid may be considered equal to the pressure of the saturated vapour corresponding to the surface temperature, and that therefore the first alternative, as mentioned above, may be adopted as correct. They do not show with certainty the small deviation from this rule, which probably takes place, and which is the point of theoretical interest.

We consider the stationary process of evaporation which occurs between two infinite, plane, parallel liquid surfaces, when they are kept at constant temperatures differing for both surfaces, and when a way is afforded by any passages soever for the evaporated liquid to return to its point of departure. All particles of vapour will pass from the one to the other surface in the direction of their common normals, and we may assume with sufficient approximation that during this transit they will neither take up nor give off heat, if we disregard the effects of radiation. On this supposition the hydrodynamic equations of movement show that the pressure, the temperature, the density, and the speed of the vapour must be constant during the entire transit from one surface to the other, whatever may be the distance. Hence follows that we know completely the occurrence in question if we can give the following magnitudes:—

1. The temperatures T_1 and T_2 of the two surfaces.
2. The temperature T , the pressure p , and the density d of the steam passing over. The temperature must be

conceived as measured by means of a thermometer moving on with the vapour with equal speed; the pressure p is also measured by a manometer moving along with the vapour, or as determined from the equation of condition of the vapour. For the latter we may approximately assume the equation of the perfect gaseous state, and therefore put $RI = p/d$.

3. The speed u , and the weight m , which passes over from a unit of the one surface to the other in a unit of time; evidently $m = u d$.

4. The pressure (P) which the vapour exerts upon the liquid surfaces. It is necessarily equal for both surfaces, and different in itself from the pressure p . We can calculate P if the other magnitudes mentioned are given. If we conceive the quantity m extended upon the unity of the surface, the pressure P resting upon the one side and the pressure p upon the other, and the temperature kept constant at T_1 , it will evaporate exactly as before, and after the unit of time it will be completely converted into vapour, will take up the space u (?), and have attained the speed u . The *vis viva* of its visible motion is therefore $\frac{1}{2} m u^2/g$, and this is obtained by the centre of gravity under influence of the power $P - p$ traversing the distance $\frac{1}{2} u$, external powers therefore performing the work $\frac{1}{2} (P - p) u$. Hence follows the equation $P - p = m u/g$, or, in conjunction with the equation under 3, $m^2 = g d (P - p)$.

The problem presented by evaporation is then to find the relation between these magnitudes for all their admissible values. Of the eight magnitudes, T_1 , T_2 , T , p , d , u , m , P , evidently two, T_1 and T_2 , and then any two others, are independent variables; the other six are connected with these by six equations: three of these equations have been given above. For a complete solution three further equations are required, either according to theory or experiment. If we select in the experiments T_1 and P as independent variables, and confine our attention to evaporation in the strictest sense, T_2 does not concern us, and the problem remains of presenting two of the magnitudes, T , p , d , u , m , as functions of T_1 and P . These functions to be determined refer not merely to the case of evaporation taking place between two parallel surfaces, but they stand good for every vapour which rises from a plane liquid surface of the temperature T_1 , and exerts upon it the pressure P . For we can conceive this evaporation taking place in such a manner that upon a surface of the temperature T_1 we allow a piston to rest, and then withdraw it from the surface at a given moment with the speed u ; the result of this experiment must be determined by T_1 and u , but a possible result is afforded us by the two functions just mentioned, and this therefore is the only one possible.

Hence the magnitudes relating to an evaporating surface are determined by two of them, and the supposition upon which the experiments were based is justified. On the other hand, our considerations show that these experiments, even if successful, would not exhaust the problem.

For the magnitudes concerned we may obtain limits if we make use of two propositions the correctness of which is rendered highly probable by general experience. They are the following:—

1. If we lower the temperature of one liquid surface among several existing in the same space whilst the temperature of the rest remains at its original point, the mean pressure upon these surfaces will thereby decrease, not increase.

2. The vapour arising from an evaporating surface is saturated or unsaturated, not supersaturated. For it appears always perfectly transparent, which would not be the case if it carried with it drops of liquid. According to the first proposition $P < p_{-1}$; according to the second $d < d_p$, if we understand by p_1 the pressure of the saturated vapour at the temperature T_1 , and by d_p the density of the saturated vapour at the pressure p . But—

$$m = \sqrt{g d (P - p)},$$

and consequently—

$$m < \sqrt{g d_p (p_1 - p)}.$$

The right member of this un-equation becomes null for $p = 0$ and for $p = p_1$, and reaches a greater value between these two pressures, which m for the surface temperature (T_1) never exceeds. But if, in spite of a sufficient supply of heat, the evaporation cannot exceed a finite limit, the hindrance lies in the nature of the liquid, and every liquid must have a specific evaporative power. The existence of such a one has therefore the same degree of probability as the two assumptions upon which our conclusion is based. The author has calculated from the above equation the following limit for m , assuming the law of Gay-Lussac and Mariotte to hold good as vapours, and adopting the following expression for the relation between the pressure and the temperature of saturated vapour:—

$$\text{Log. } p = 10.59271 - 0.847 \log. T - 3342/T.$$

Dividing the magnitudes (m) obtained by the specific gravity of mercury, he obtained values for the utmost depth of the liquid stratum which in a unit of time can evaporate from a surface at a given temperature. These values, calculated in m.m./minutes, are— $T = 100$, $h < 0.70$, $u < 2110$, $P > 0.046$, $d/d_1 > 0.0034$. These values are about ten times higher than the highest values which have been observed at corresponding temperatures. The latter the author gives as the minimum limits, not for evaporation in general, which may be null, but they are minimum limits for the greatest possible rate of evaporation. The figures show that we are unable to effect by any means the evaporation at 100° of more than 0.7 m.m. per minute from a surface of mercury; that the vapour from the surface exhales at a greater speed than 2110 m. sec. from the surface; that the pressure upon the surface is smaller than 4 to 5 hundredths of a millimetre; or that the density of the exhaled vapour is less than $1/3000$ of the density of saturated vapour. On the other hand, we may effect an evaporation of more than 0.08 m.m./minute, that the speed of the vapour is greater 7.3 m./sec., and that the pressure of the exhaling vapour differs from that of saturated vapour by more than $1/3000$ of the value of the latter.

In conclusion, the author remarks that the existence of a definite rate of evaporation peculiar to every liquid corresponds to the views of the kinetic theory of gases, and that a tolerably certain maximum limit for the speed in question can be founded upon this conception. Let T , p , and d be now respectively the temperature, the pressure, and the density of saturated vapour, then—

$$m = \sqrt{p d g / 2\pi}$$

is that weight which in a unit of time impinges upon a solid surface forming the boundary of the vapour. Almost the same quantity must in a very rare vapour impinge upon the liquid boundary surface, as the molecules at their mean distance from the surface will be withdrawn from the influence of the latter. But as the quantity of saturated vapour neither increases nor decreases, we may conclude that an equal quantity of the liquid is thrown off as vapour. This quantity proceeding from the liquid will be almost independent of that taken up. Hence occurs decrease of the liquid, because the vapour from whatever grounds brings back to the liquid a smaller weight than that just named; and in the extreme case, that no molecules return to the liquid, the latter, in a unit of time, will lose the above quantity from a unit of its surface. This quantity is therefore the maximum limit of the speed of evaporation, and is somewhat lower than that formerly ascertained. For mercury calculation shows this limit at 100° to be 0.54 m.m. per minute, whilst from our former suppositions we could merely infer that the rate of evaporation must fall short of 0.70 m.m. per minute. Similar conclusions may be applied to the energy which can at most proceed from an evaporating surface. It appears that the speed of the exhaling vapour can never be greater than

he mean molecular speed of the saturated vapour corresponding to the surface temperature; *e.g.*, for mercury, at the temperature of mercury, it never can be greater than 215 m./sec. As the pressure of a saturated vapour upon its liquid proceeds to the extent of one-half from the shock of the molecules entering the liquid, the other half being due to the reaction of the molecules leaving the surface, and as the number and the mean speed of the latter remain approximately at their original value, it may be inferred that the pressure upon an evaporating surface is not essentially less than the half of the saturation pressure.

These considerations can merely be used for establishing limit-values, unless we are prepared to call in the aid of very questionable hypotheses.—*Wiedemann's Annalen* (1882, p. 177.)

DETERMINATION OF PHOSPHORIC ACID BY THE MOLYBDIC METHOD.

By Dr. C. STUNKEL, Dr. T. WETZKE, and
Prof. PAUL WAGNER.

ACCORDING to the authors' experience the subjoined is the best method of carrying out this process:—

From 20 to 25 c.c. of a solution of phosphate free from silica and containing 0.1 to 0.2 grm. of phosphoric acid, are placed in a beaker, and mixed with so much solution of ammonium nitrate (see below), and so much molybdic solution, that the total liquid may contain 15 per cent ammonium nitrate, and not less than 50 c.c. of molybdic solution per 0.1 grm. phosphoric acid. The contents of the beaker are heated to 80° to 90° in the water-bath, set aside for an hour, filtered, and the precipitate washed with dilute solution ammonium nitrate. The beaker is now set under the funnel, the filter pierced with a platinum wire, the precipitate rinsed into the beaker with ammonia at 2½ per cent, washing the filter-paper well, dissolved, stirring with a glass rod, and ultimately so much of the weak ammonia added as to make up the volume of the liquid to about 75 c.c. To 0.1 grm. phosphoric acid 10 c.c. magnesia mixture are dropped in, stirring continually; the beaker is covered with a glass plate, and set aside for two hours. The precipitate is then filtered off, washed with ammonia at 2 per cent, and dried. The precipitate is introduced into a platinum crucible, putting in also the rolled up filter, the crucible is covered, and heated till the filter is carbonised. It is then placed in a slanting position in the flame of a Bunsen burner for ten minutes, and is afterwards ignited before the blast for five minutes, let cool in the desiccator, and weighed.

The concentration of the solutions to be employed is as follows:—

1. Molybdic solution.—150 grms. ammonium molybdate is dissolved with water so as to make 1 litre, and poured into 1 litre nitric acid of specific gravity 1.2.

2. Concentrated solution ammonium nitrate.—750 grms. ammonium nitrate dissolved with water to the bulk of 1 litre.

3. Dilute solution ammonium nitrate.—100 grms. ammonium nitrate dissolved in water to the bulk of 1 litre.

4. Magnesia mixture.—55 grms. crystalline magnesium mixture and 70 grms. ammonium chloride are dissolved in 1 litre ammonia at 2½ per cent.

The process differs in three points from that commonly followed:—

1. The precipitation and washing of the molybdic precipitate is executed in presence of ammonium nitrate, for the practical purpose of economising time, and molybdic and nitric acids.

2. The authors rinse the precipitate from the perforated filter with ammonia at 2½ per cent, and add the magnesia mixture at once, whilst generally the precipitate is dissolved on the filter with heated concentrated ammonia,

the ammoniacal liquid is neutralised with hydrochloric acid, the liquid, which is thus heated, is allowed to cool, then mixed with magnesia mixture, and finally diluted by one-third with ammonia. This modification of the common process is recommended for practical reasons.

3. The magnesia mixture is added drop by drop, and with continual stirring, whilst other instructions are silent on this head. These precautions are given because otherwise an impure precipitate and an excess of phosphoric acid are obtained.

As regards the first point, E. Richters demonstrated ten years ago that the separation of the molybdic precipitate, which is interfered with by the presence of much acid and certain salts, *e.g.*, potassium and sodium sulphates, is greatly facilitated by the addition of ammonium nitrate. This recommendation is also given by Gilbert. The authors have found, in an especial series of experiments, that a much smaller excess of molybdic solution suffices if ammonium nitrate is present.

They have also found experimentally that the application of a heat of 80° and a rest of one hour will suffice to effect the precipitation of all the phosphoric acid. If the temperature exceeds 90°, free molybdic acid separates out, which does not readily dissolve in ammonia, and is therefore troublesome.

The molybdic precipitate is insoluble both in dilute molybdic solution and in a 15 per cent solution of ammonium nitrate slightly acidulated with nitric acid. Hence this mixture may be safely used for washing the precipitate, even without the addition of molybdic solution. But the authors find, further, that a 10 per cent solution of ammonium nitrate gives satisfactory results, even without acidulation with nitric acid, and this accordingly they recommend.

The reason for the direct addition of magnesia mixture to the ammoniacal solution of the molybdic precipitate is as follows: The simple rinsing the precipitate from the filter, and washing the paper with dilute ammonia, is much more easily and readily effected than dissolving the precipitate upon the filter with hot ammonia followed up in the ordinary manner, by which, further, too much ammonium chloride is often formed.

As regards the third point the authors have previously pointed out that a sudden addition of magnesia mixture occasions an impure precipitate. A pure precipitate and an accurate result can be obtained only by a very gradual addition of the magnesia mixture with constant stirring.

There remain only three questions:—

1. In how far is the degree of concentration of the solution of influence in precipitation with magnesia mixture? The experimental reply is that it may safely vary within wide limits.

2. How long must the solution be let stand, after the addition of the magnesia mixture, before it can be filtered? The results of the authors, in accord with those of Abesser, Jani, and Märcker, show that it is not merely unnecessary to allow the mixture to stand twelve to twenty-four hours, as was formerly customary, but, on the average, more accurate results are obtained (supposing a quantity of phosphoric acid exceeding 0.1 m.grm.) by filtering after about two hours.

3. In how far is the concentration of the ammonia used for washing of the magnesia precipitate of importance? The authors conclude that the solubility of the magnesia precipitate is so vanishingly small that there is no need to cut short the washing, as is almost always recommended.—*Zeit. Anal. Chemie*, xxi., 353.

Royal Institution.—Dr. William H. Stone will give the first of three lectures on "Singing, Speaking, and Stammering," on Saturday, February 17; and Professor Robert S. Ball will give the first of four lectures on "The Supreme Discoveries in Astronomy," on Tuesday, February 20.

ON THE PRESENT CONDITION OF THE SODA INDUSTRY.*

By WALTER WELDON, F.R.S.,
Chevalier de la Légion d'Honneur.

ABOUT a fortnight ago the *Times* spoke of the manufacture of soda by the Leblanc process as being, "to some extent, a dying industry." Although I hope to show this evening ground for believing that that industry is not going to die just yet, it has certainly for some time past been in a condition by no means satisfactory to the greater number of those whose capital is engaged in it. For manufacturers of soda by the Leblanc process recent years have been years, in very many cases of loss, and in not a few cases of disaster. Of twenty-five alkali works which were in operation in the neighbourhood of Newcastle-on-Tyne a very few years ago, only thirteen are in operation now; and of the other twelve,† not fewer than eight have been actually dismantled, in utter despair of its ever again being possible to manufacture soda in them by the Leblanc process except at an absolute loss. The alkali-making districts of Lancashire have advantages over the Newcastle district in respect alike of the price of salt, of facilities for supplying the American market, and of nearness to certain of the great English centres of soda-consumption; but, nevertheless, even in Lancashire some seven or eight alkali-works are standing idle, and but few of the others are working up to their full capacity. In Belgium, where there are five or six works which formerly made soda by the Leblanc process, matters are even worse, since in that country the manufacture of Leblanc soda has entirely ceased. The only other European countries in which the soda-industry as yet exists are France, Germany, and Austria. In these countries the soda-manufacture is protected by the import duties which are stated in the following table:—

IMPORT DUTIES PER TON.

	France. Francs.	Germany. Marks.	Austria. Florins.
Soda-ash	41	25	12
„ crystals	19	15	8
Caustic soda	64	40	40
Bleaching-powder ..	35.5	30	15

—duties which, I believe, more than compensate for the greater cost of raw materials in those countries than in England; while in all these countries there is, moreover, a large demand for that by-product of the Leblanc process, hydrochloric acid. Notwithstanding that the French, German, and Austrian manufacturers of Leblanc soda have thus two very sensible advantages over their fellow-manufacturers in this country, they have, nevertheless, grave cause for anxiety; the French manufacturers, indeed, in part owing to a special circumstance which I will mention presently, having reason to regard the future, not only with alarm, but even with dismay.

From information kindly supplied to me by manufacturers in all the countries in which the soda-industry is practised, I have been enabled to draw up a statement of the present total soda-production of the world, and of the proportions in which that production is divided between the Leblanc process and the ammonia process. In drawing up the following Table, I have converted all the figures supplied to me, alike those for soda-ash, those for crystals, those for caustic soda, those for bicarbonate, and those for black-ash sold as such, into terms of pure Na_2CO_3 :—

PRESENT SODA PRODUCTION OF THE WORLD.

	Leblanc Soda.	Ammonia Soda.	Totals.	Ammonia Soda per cent of Total Soda.
Great Britain ..	380,000	52,000	432,000	12.0
France	70,000	57,125	127,125	44.9
Germany	56,500	44,000	100,500	43.8
Austria	39,000	1,000	40,000	2.5
Belgium	—	8,000	8,000	100.0
United States ..	—	1,100	1,100	100.0
Total ..	545,500	163,225	708,725	23.0

This table shows that the total quantity of soda now being manufactured annually is nearly 710,000 tons, and that of this quantity more than 163,000 tons are produced by the ammonia process.

I need scarcely say that it is to the very rapid growth of this latter process that is mainly due that condition of the Leblanc process which I have endeavoured to indicate. Although it is now more than forty-seven years since the ammonia process was first proposed by Dyer and Hemming, it is less than seventeen years since that process was first realised industrially. As an industrial process, capable of being worked continuously and with satisfactory commercial results, the ammonia process dates only from 1866, being the year in which M. Ernest Solvay, of Brussels, began to produce ammonia-soda at works which he had established for the purpose at Couillet, near Charleroi. M. Solvay has now two other ammonia-soda works in operation,—one in France, at Varangeville-Dombasle, near Nancy, and one in South Germany, at Wyhlen, in the Grand Duchy of Baden,—and by his courtesy I am enabled to place before you the following statement of the quantities of ammonia-soda which he has manufactured in each completed twelve months from the 1st of May, 1866:—

	Tons.	
1866-67 ..	179	Couillet only.
1867-68 ..	465	
1868-69 ..	719	
1869-70 ..	940	
1870-71 ..	1,862	
1871-72 ..	2,805	Couillet and Dombasle.
1872-73 ..	3,423	
1873-74 ..	3,980	
1874-75 ..	4,678	
1875-76 ..	5,768	
1876-77 ..	11,579	Couillet, Dombasle, and Wyhlen.
1877-78 ..	19,247	
1878-79 ..	25,023	
1879-80 ..	32,326	
1880-81 ..	42,669	
1881-82 ..	53,400	

These figures come down to the 30th April last. Since that date, however, M. Solvay has increased his production by nearly 60 tons per day, or 21,000 tons per annum, so that he is now making ammonia-soda at the rate of very nearly 75,000 tons a year. He is thus making ammonia-soda on nearly three times the scale on which he was making it four years ago, and on nearly twice the scale on which he was making it only two years ago. In France and Germany, M. Solvay's great success has tempted other manufacturers into the field, and, although none of them are as yet large makers, their total production amounts to fully 35,000 tons per annum, raising the total Continental production of ammonia-soda to about 110,000 tons per annum, out of a total production by both processes of 275,000 tons. Of the total soda now being made on the Continent, therefore, about 40 per cent is being made by the ammonia process. While the quantity of Leblanc soda made in France has neither increased nor diminished during the last few years, the quantity of Leblanc soda made in Germany and Austria has increased by several times the quantity formerly made in Belgium;

* A Paper read before the London Section of the Society of Chemical Industry, at the Chemical Society's Rooms, Burlington House, London, Monday, January 8, 1883, by the Chairman of the Section.

† The quantity of salt decomposed in these twelve works was about 67,000 tons a year. The quantity decomposed in the thirteen works still in operation is about 220,000 tons a year.

so that not only these 110,000 tons of ammonia-soda per annum, but also fully 25,000 tons per annum of Leblanc soda, have been added, comparatively recently, to the soda production of the Continent: going partly to supply increased consumption, but largely to diminish importation from England. And of this vast increase in the Continental production of soda,—four-fifths of which increase is due to the ammonia process,—two-thirds have sprung into existence within the last five years, and a large part of those two-thirds within only two years.

In England, within the last two years, the production of ammonia-soda has been nearly trebled. The ammonia process is practised in this country as yet only by one firm. In 1873 it was not in operation in this country at all. In that year our Honorary Foreign Secretary, Mr. Ludwig Mond, arranged with M. Solvay for the right to work under his patents in this country, and in the following year, in conjunction with Mr. J. T. Brunner, Mr. Mond began to make ammonia-soda at Winnington, near Northwich. Messrs. Brunner and Mond began on a very modest scale, their production in 1875 not exceeding 2500 tons; but in 1878 their production rose to 10,000 tons; in 1880 it was 18,800 tons; and it is now at the rate of not less than 52,000 tons per annum, or at very nearly three times the rate of only two years ago.

The competition of the ammonia process with the Leblanc process has thus attained its present degree of seriousness only very recently indeed. It has come upon the makers of the Leblanc soda almost like a thunderbolt out of a clear sky.

And, serious as that competition is already, it is about to become even more serious still. Not only is it to be expected of the existing ammonia-soda works that those of them which have recently so greatly increased their production will go on increasing their production, and that those of them which have more recently started will grow as the older ammonia-soda works have grown, but new ammonia-soda works are being built. M. Solvay, who has already, as I have said, a work in operation in South Germany besides his French and Belgian works, and who is already by far the largest soda-maker in the world, will soon have a work in operation in North Germany also, at Bernburg, near Stassfurt; and he is now, moreover, erecting a work in Russia, and also a work in the United States, and is on the point of commencing the erection of a work in Austria, so that by-and-bye he will be making soda in no fewer than seven distinct works, in six different countries. In addition to all this, a large work to make ammonia-soda, not on M. Solvay's system, but on a system modified from that practised at Dieuze, is being erected near Stassfurt by the Company of Buckau; an ammonia-soda-work is building, and will be started in the spring, at Favorznow, near Cracow; and one is about to be built at Siebenburgen, in Transylvania,—not to speak of the intention of Messrs. Bell Brothers to build an ammonia-soda work at Middlesbro'. The new works which are thus in course of construction, and some of which are nearly completed, will throw on the market more ammonia soda, to the extent of not less, from the commencement, than from 65,000 to 70,000 tons a year.* For Leblanc soda-makers, it is thus as though ammonia-soda had latterly rained from the skies during two days out of every three, and the showers were now on the point of becoming continuous.

While face to face with so serious an amount of competition, actual and imminent, on the part of the ammonia process, the Leblanc process pure and simple is now

further threatened with what is surely the "most unkindest cut of all," namely, with competition from the Leblanc process itself—combined with the extraction of copper from Spanish pyrites.

To explain how this has come about, I must remind you that the sulphuric acid used in the Leblanc process is now invariably manufactured from the sulphur of pyrites; that the pyrites used in this country is now almost exclusively either Spanish or Portuguese pyrites, containing two to three per cent of copper and very small quantities of silver and gold; that after most of the sulphur has been burnt off from the pyrites, as the first step in the manufacture of sulphuric acid, the residual "burnt ore," or "pyrites cinders," as it is called, is treated by the wet way for the extraction from it of copper, and in most cases now of gold and silver also;* and that what remains when these have been extracted is an almost pure oxide of iron, which finds a ready sale for use for various purposes in connection with the manufacture of iron and steel. The supply of this cupreous pyrites is for the most part monopolised by three great companies—the Tharsis Company, the Rio Tinto Company, and Messrs. Mason and Barry. These companies not only supply nearly the whole of the pyrites used in the manufacture of sulphuric acid in England, but the Rio Tinto Company also supplies annually some 60,000 tons of pyrites to Germany, and is also beginning to send pyrites into Austria. None of the three Companies, however, has been able to sell an ounce of pyrites in France.

The reason of this is that in France itself there are two large deposits of pyrites, both belonging to soda-makers; one belonging to the Compagnie de St. Gobain, and the other to MM. Pechiney et Cie. Each of these companies itself uses its own pyrites; and the former of them supplies with pyrites the greater number of the other alkali-makers in the North of France, while the latter supplies with pyrites all the other alkali-makers of the South of France. It has obviously been impossible to sell Spanish pyrites to either of the two great soda-making firms, each of which thus has pyrites, and by no means dear pyrites, of its own, and each of which is a large seller of pyrites to other soda-makers; and the other French soda-makers, for the most part, have been precluded from even considering the question of changing to Spanish pyrites, if only by reason of the French habit of contracting for the supply of raw materials over very long periods. A French manufacturer's contract for raw materials is generally a contract for fifteen years; and most of the French soda-makers are now obtaining their pyrites under contracts which have yet a considerable time to run.

Under these circumstances the Rio Tinto Company has taken a remarkable step. To understand the motive to this step, it must be borne in mind that while French pyrites does not contain copper, and so has scarcely any value beyond that of the sulphur which it contains, Spanish pyrites has a considerable value in addition to its sulphur value. While the value of Spanish pyrites for the sulphur in it is equal to that of the best non-cupreous pyrites, its value for copper is greater than its value for sulphur, and, not to speak of its value as regards precious metals, it has also a considerable value for its iron. In this country, the cinders left after as much as possible of the sulphur of non-cupreous pyrites has been burnt off are considered to have no value at all; and even in France—where the import duty on cast-iron is greater than the present price of Glasgow pigs, and where all forms of iron are therefore appreciably more valuable than in this country,—the cinders of non-cupreous pyrites are not worth more than three francs per ton. They always contain sulphur, and sometimes contain phosphorus. The cinders of cupreous pyrites, before treatment for the extraction of copper from them, also contain sulphur, and in larger

* As no complete list of ammonia-soda works has yet been published, it may be interesting here to give one. The following list includes all the works now actually in operation:—ENGLAND:—Winnington, Sandbach. GERMANY:—Wyhlen, Duisburg, Icowiazlow, Grevenberg, Dieuze, Trotha, Heilbronn, Nürnberg, Rothenfelde. FRANCE:—Dombasle, Giraud, Sorgues, St. Denis, Lille. BELGIUM:—Couillet. AUSTRIA:—Boszko. UNITED STATES:—Bay City. Ammonia-soda works are now being built in the following localities:—AUSTRIA:—Favorznow, Siebenburgen. (?). RUSSIA:—Beresniki. GERMANY:—Stassfurt, Bernburg. UNITED STATES:—Syracuse. There is a reason why the locality of the work which M. Solvay is about to build in Austria may not yet be published.

* A German analysis of Rio Tinto pyrites gives the following results per 1000 kilos:—Sulphur, 495 kilos.; iron, 430 kilos.; copper, 30 kilos.; lead, 10 kilos.; silver, 26 grms.; gold, 180 m.grms.; bismuth, 150 grms.

quantity than the cinders of non-cupreous pyrites; but the treatment to which they are subjected for the extraction of their copper removes the whole of their sulphur, and also the whole of their phosphorus, if they have contained any, leaving a residual oxide of iron of great purity. This residual oxide, or "purple ore," as it is called, now sells in this country for twelve shillings per ton, and in France it would doubtless command a higher price.

Now, in this country a state of things has grown up under which the manufacturers of Leblanc soda derive no advantage from the value for copper and iron of the pyrites which they employ. The treatment of the cinders of cupreous pyrites has become in this country a separate industry, practised only in a few instances by alkali-makers themselves, but practised for the most part by Companies or individuals who do not themselves make soda, but who either buy from soda-makers the cinders of pyrites of which the soda-makers have bought both values, the copper value as well as the sulphur value, or themselves buy both values, selling only the sulphur value to the soda-makers, or else buy direct from the pyrites sellers the copper value only: the pyrites sellers in such cases selling the copper value of their pyrites to one purchaser and its sulphur value to another. It is an industry which yields fair commercial profits, so that soda-makers may be incurring actual loss, while those who deal with the cinders of the pyrites from which the soda-makers have burnt off sulphur are at least making a living. And while the treatment of the cinders of Spanish pyrites is fairly profitable in this country, the greater value of iron and iron ores there than here would doubtless render it more profitable in France. It is true that coal is more costly in France than in England; but the quantity of coal required for treating pyrites cinders is not great.

The course, then, which the Rio Tinto Company is taking is this. Unable to sell its pyrites to the French Leblanc soda-makers, it has determined that the Leblanc soda made in France, or at least a large part of it, shall nevertheless be made by means of Rio Tinto pyrites, and to this end it has promoted a subsidiary company, "La Compagnie d'Exploitation des Minerais de Rio Tinto," which Company is to make Leblanc soda in France and elsewhere, relying for its profits neither on soda nor on chlorine, but on copper and oxide of iron. For this company, soda and chlorine will be simply by-products, which it will be glad to sell at a profit, if that may be, but which, if that may not be, it will be content to sell at the bare cost of manufacturing them. It will manufacture them only for the sake of converting Rio Tinto pyrites into pyrites cinders.

This new company proposes to operate upon an enormous scale. It has a capital of £1,200,000 sterling, of which one-half is already paid up, and there is talk of its building in France no fewer than five great works: one of which, designed, and to be managed, by Englishmen, it has already commenced, in the neighbourhood of Marseilles. The result cannot but be very grave for the existing French Leblanc soda-makers, and must inevitably affect the makers, both of Leblanc soda and of ammonia-soda, in this country also.

Moreover, this new company will not confine its operations to France. Not only will it take Spanish pyrites to the United States, and there make sulphuric acid, extract copper, and obtain "purple ore"—large quantities of which at present go from England to America,—but it will also build a large soda-making and copper-extracting work,—which will certainly affect the English alkali trade,—in the neighbourhood of Antwerp. The Leblanc process will thus be re-introduced into Belgium, not as a substantive process, but simply as a part of a combination of processes for the utilisation of cupreous pyrites.

To such complexion has the Leblanc process come at last. Originally, soda was its only commercial product, the hydrochloric acid produced during the first stage of it being turned to no account. In time a demand grew up

for chlorine, that hydrochloric acid began to be utilised, and the manufacturers of Leblanc soda now sent into the market two products, by each of which they gained profits. Then their soda ceased to be profitable, and became a kind of by-product, which they continued to make only because they could not otherwise make chlorine. Now, Leblanc soda gives no profit at all, and chlorine none to speak of; and both have come to be regarded as secondary products, to be made only incidentally, and only because making them is essential to the application to certain ores of the wet method of extracting copper.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

THE minutes of the previous meeting were read and confirmed.

The following certificates were read for the first time:—G. Board, J. J. Knight, J. O'Sullivan, A. Vasey, T. D. Watson, R. M. Walmsley.

During the evening a ballot was held, and the following were declared by the Scrutators, Messrs. J. Spiller and W. Thorp, to be duly elected:—As Foreign Members—F. Beilstein, P. T. Clève, H. Debray, E. Erlenmeyer, R. Fittig, H. Helmholtz, D. Mendeleeff, Victor Meyer, Lothar Meyer. As Ordinary Fellows—H. C. Bond, G. Chandra Basu, J. Brock, A. M. Chance, J. T. Donald, H. C. Foote, W. Fox, W. R. Flett, J. A. M. Fallon, E. C. Gill, F. Gothard, J. Hunter, H. Jones, R. B. Lee, A. H. Jackson, Joowansinghi, T. Jenner, J. E. Johnson, W. W. J. Nicol, F. W. Richardson, E. S. Spencer, C. A. Serré, J. Turner, J. E. Tuit.

Dr. HODGKINSON then communicated to the Society a paper "*On Derivatives of Fluorene*," by W. R. E. HODGKINSON and F. E. MATTHEWS. Since Berthelot first isolated diphenylen-methane from coal-tar oil, this body—termed fluorene from its supposed fluorescent properties—has been studied by several chemists. The object of the present investigation was to obtain a hydroxy derivative. The fluorene was obtained in a state of approximate purity from Schuchardt and Kahlbaum. It was crystallised five or six times from hot alcohol, those crystals only being reserved which fell out between 25° to 30°, and thus a pure product, melting constantly at 113° and boiling at 298° to 305°, was obtained. The slight fluorescence of this pure product can be entirely removed by sublimation over a little potassium carbonate. A dibrom-fluorene, $C_{13}H_8Br_2$, and a monobrom-fluorene, $C_{13}H_9Br$, were obtained; both these bodies yield, on oxidation, a substituted diphenylen-ketone. The authors have also prepared fluorene-sulphonic acid, $C_{13}H_9SO_3H$, by treating a chloroform solution of fluorene with SO_3HCl ; the potassium, barium, and cadmium salts were prepared and analysed. On heating the potassium sulphonate with potash to 400° C., acidifying the product, and distilling in a current of steam, a white crystalline substance came over,—consisting of a substance melting at 205°, having the composition $C_{12}H_{10}O_3$, and a second substance much more soluble in water. This extraordinary result, the formation of trihydroxy-diphenyl, can only be brought about by the splitting off of the methylen group in fluorene, and its replacement by two hydroxyl groups. By dropping the hydrocarbon into fused potash a dihydroxy-diphenyl, $C_{12}H_{10}O_2$, melting at 98°, was prepared. The authors shortly discuss the constitution of these bodies. The authors have also prepared dichlor-fluorene, $C_{13}H_8Cl_2$, by passing chlorine through a cold chloroform solution of

fluorene. By using boiling chloroform a substance, $C_{13}H_5Cl_7$, is obtained. A completely different action takes place when chlorine is passed into boiling fluorene. Fused potash acts energetically on these chloro-derivatives.

Mr. R. COWPER then read a paper "*On the Action of Chlorine on Certain Metals.*" As previously noticed by Wanklyn, dry chlorine is quite unable to act upon metallic sodium. The author finds that chlorine which has been perfectly dried by long contact with fused calcium chloride is without action on Dutch metal foil. On introducing a minute quantity of water the ordinary reaction ensues immediately. Similarly zinc foil and magnesium are not attacked. Silver and bismuth are tarnished very slowly. Tin foil, arsenic, and antimony are attacked immediately. The author remarks that these three metals all form chlorides which are liquid at ordinary temperatures. Chlorine, whether dry or moist, attacks mercury. If dried chlorine be passed over a piece of potassium the latter catches fire; this is probably caused by the envelope of hydrate. Potassium was sealed up in a tube containing dry air. The tube was then heated until all the oxygen was absorbed and a bright surface of potassium was obtained; the tube was then filled with chlorine. The surface of the metal became slowly covered with a deep purple film, and the potassium finally ignited when heated considerably above its melting-point.

Dr. ARMSTRONG suggested that the author should dry the chlorine with phosphoric anhydride, and then try its action upon antimony; it was most important to settle the question whether two bodies could act upon each other without the presence of a third: thus in most text-books it was stated that zinc dissolved in sulphuric acid; now zinc is quite insoluble in sulphuric acid, and the presence of water is necessary to effect solution.

Mr. J. SPILLER asked if the author had ascertained, in an alloy, whether chlorine attacked one metal, leaving the other untouched,—as, for instance, an alloy of zinc and tin.

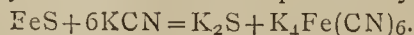
Mr. GROVES said that bromine, when dry, had no action upon zinc, but acted violently upon antimony and tin.

Dr. HODGKINSON mentioned that sulphur dioxide and sulphuretted hydrogen did not act upon each other if perfectly dry.

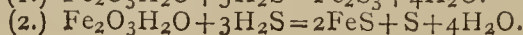
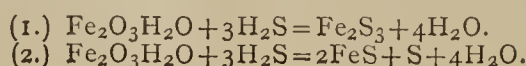
Prof. MCLEOD said that similarly carbonic oxide and oxygen did not explode if free from moisture.

Mr. COWPER, in reply, said that he had not tried the action of chlorine upon an alloy of zinc and tin, nor upon phosphorus.

Mr. L. T. WRIGHT then read a paper entitled "*Some Notes on Hydrated Ferric Oxide, and its Behaviour with Sulphuretted Hydrogen.*" The author endeavoured to prepare hydrated ferric oxide by precipitating the chloride with ammonia, but could not succeed in preparing it free from basic chloride. In order to avoid the inconvenience of handling a bulky gelatinous precipitate, the following method was tried:—Ferric chloride solution was added slowly to an excess of ammonia, and the whole evaporated to dryness at 100° . The reddish brown mass, on treatment with water, fell into an impalpable powder, which for the most part passed through many filter-papers. The filtrates were turbid, and of a bright red colour. In this condition the precipitate is probably similar to the so-called "colloidal ferric hydrate." The ferric hydrate in this condition is not blackened by sulphuretted hydrogen. Recently precipitated ferric hydrate is blackened at once by sulphuretted hydrogen, and the sulphide thus formed is completely soluble in excess of potassic cyanide,—



Two equations are given in text-books to express the reaction of sulphuretted hydrogen upon hydrated ferric oxide:—



The author has studied the reaction, estimating the sulphur and the water formed.

Mr. PAGE suggested that it would be interesting to know whether the finely divided precipitate could be filtered off by sucking the fluid by a Sprengel pump through porous porcelain, milk when thus filtered through the porous cell of a Daniell battery furnishing a perfectly transparent filtrate, almost free from albuminous bodies and fats, but containing the sugar and salts.

The SECRETARY then read a paper "*On Alpha-cyanonaphthalene Sulphonic Acid,*" by U. K. DUTT. The author first prepares naphthalene-alpha sulphonic acid by heating naphthalene in carbon disulphide solution with sulphuric hydrochloride. The acid was converted into a potassium salt, which was distilled with an equal quantity of potassium ferrocyanide. The product was crystallised from light petroleum, and obtained as yellowish acicular crystals, melting at 36° . This α -cyano-naphthalene was dissolved in carbon disulphide and treated with sulphuric hydrochloride, and thus brilliant colourless laminar crystals of α -cyano-sulphonic acid were obtained. The barium salt was also prepared and analysed by the author.

The Society then adjourned till February 15th, when the following paper will be read:—"On some Derivatives of Diphenyl-ketone Oxide," by A. G. PERKIN.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, February 5, 1883.

GEORGE BUSK, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

THE Duke of Bedford, K.G., Lord Lawrence, Major Gerald Edmund Boyle, Mrs. Henry Bonham Carter, Joshua Fielden, Esq., Major Alexander Thomas Fraser, R.E., and Mrs. Clara E. Murchison were elected Members of the Royal Institution.

Ten candidates for membership were proposed for election.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

CORRESPONDENCE.

ALKALINE PERMANGANATE FREE FROM AMMONIA.

To the Editor of the Chemical News.

SIR,—The CHEMICAL NEWS, vol. xlv., p. 284, contains a paper by Mr. J. Stapleton, on the difficulty of preparing alkaline permanganate free from ammonia. I have found that the method advocated by the Water Committee of the Society of Public Analysts yields a product as pure as that of your correspondent, provided *recently-distilled* water be used in its preparation.

A few days ago I determined the amount of ammonia in some permanganate solution that has been made for *more than two years* (and which I have used for purposes of instruction in water analysis only). When distilled with perfectly pure water it yielded but 0.01 m.grm. per litre. When tried with the ordinary distilled water used in the laboratory (after distilling off free NH_3), it yielded 0.04 m.grm. per litre, showing the effect of dust in the water.

I think it is quite as necessary to pay attention to the preparation of the Na_2CO_3 solution as to the permanganate.—I am, &c.,

A. PERCY SMITH.

Temple Observatory, Rugby
February 2, 1883.

INSOLUBILITY OF AMMONIO-MAGNESIA PHOSPHATE IN DILUTE AMMONIA.

To the Editor of the Chemical News.

SIR,—In a communication to the CHEMICAL NEWS, vol. xlvii., p. 9, Mr. David Lindo, has noticed that I make no allowance for the solvent action of dilute ammonia upon ammonio-magnesia phosphate in my paper upon the "Estimation of Phosphoric Acid as Magnesian Pyrophosphate," published in the CHEMICAL NEWS, vol. xlv., p. 213.

The rejection of such allowance was made with a full understanding of the subject, and I am glad to avail myself of the present opportunity of reviewing the history of this matter.

In his "Anleitung zur Quant. Anal.," 5 Aufl., 333, Fresenius recommended an allowance of 0.001 grm. $Mg_2P_2O_7$ for every 54 c.c. of mother-liquor and of washings employed in estimating P_2O_5 by precipitating as ammonio-magnesia phosphate.

Very seldom have the need of the utmost certainty on the part of one recognised as authority in any department of science, and the mischievous results of a single error on his part, been better illustrated than in this particular case, for, though in the very next edition of the same work, Fresenius himself withdrew this allowance, and, though it has been shown to be wholly incorrect again and again by careful experimenters, yet the allowance still lives a vigorous life in many quarters.

The facts in regard to the case seem to be as follows:—

1. That while ammonio-magnesia phosphate is soluble to a small extent in dilute ammonia containing a very large amount of ammonium chloride

2. This solubility is decreased (a) by the absence of an ammonia salt, (b) by the presence of an excess of magnesia salt, and (c) by an increase in the amount of ammonia present, until it becomes so slight as to be for all practical purposes absolutely nothing.

The grounds for this opinion may be briefly stated as follows:—

I. In my own experiments upon this subject, when the first precipitates were dissolved in HCl and again precipitated, and when consequently only the minutest traces if any of retained impurities could be present, and when the precipitates were exposed to the solvent action of at least 400 c.c. of ammonia water, yet the amount dissolved was so insignificant as not to affect the result in the slightest.

II. A series of experiments made by Kubel (*Zeit. für Anal. Chemie*, viii., 125) in the same way, with the exception that the precipitates were *twice* dissolved and re-precipitated, gave 99.80 per cent of the theoretical amount, and, when *three times* dissolved and re-precipitated, gave 99.2 per cent. Remembering that in these cases there is present a considerable amount of ammonium chloride (which increases the solubility of the precipitate), and noticing how extremely small was this solubility, even under such unfavourable conditions, it can readily be understood how this solubility becomes a *vanishing* quantity when there is only a trace of ammonium chloride present (coming from the small amount in the magnesia mixture employed as a precipitant), when the salt is exposed to only *one* precipitation and washing, instead of *four* as above, and where the ammonia wash-water used is very strong, as in the method of procedure most highly recommended by me in the article referred to.

III. As other authorities on this point may be quoted, Abesser, Jani, and Maercker (*Zeit. f. Anal. Chem.*, xii., 239); Gooch (*Amer. Chem. Journal*, i., 391), who makes no allowance for the alleged solubility in question, and yet after double precipitation obtains accurate results; and finally, as the latest and most exhaustive treatise on this whole subject, I refer to the paper of Stünkel, Wetzke, and Wagner (*Zeit. f. Anal. Chem.*, xxi., 353),—a paper which you will pardon me for hoping will soon be trans-

lated and published in the CHEMICAL NEWS,* because of the value and accuracy of the methods there recommended. These last authors there demonstrate that when used for washing the ammonio-magnesia-phosphate precipitate—

1000 c.c. 1 per ct. ammonia water dissolve	0.88 grm. P_2O_5
1000 c.c. 2 " " " " "	0.23 " "
1000 c.c. 3 " " " " "	0.15 " "

As in my work I used about 200 c.c. of mother-liquor^r and wash-water combined, composed of 1 part strong ammonia liquor to 3 parts water, the absolute insignificance of any solvent action can be seen at once.

Our experience since the publication of my paper leads us to believe more positively than ever that the gradual addition of the magnesia mixture, at the rate of one drop a second, to the solution of phosphate, accompanied by constant stirring, brings down an exceedingly fine precipitate, perfectly free from any trace of retained impurity, which practically is absolutely insoluble in strong ammonia water.

Hoping that your publication of this review will assist in laying this unhappy ghost so long detained after sunrise from its proper resting-place,—I am, &c.,

THOMAS S. GLADDING.

Laboratory of Stillwell and Gladding,
New York.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 3, 1882.

Determination of Sulphurous Acid in Air.—B. Proskauer.—The author passes a known volume of air through 50 or 75 c.c. of a solution of permanganate containing 15 grms. of the crystalline salt per litre. To prevent the formation of hydro-sulphurous acid, 2 or 3 c.c. of hydrochloric acid are added. The solution is placed in a Bunsen bulb-tube.

Valuation of Commercial Lead Peroxide.—H. Fleck recommends the introduction of a weighed quantity (0.5 grm.) into a standard solution of ammonium ferrous sulphate, adding not more hydrochloric acid than is required for the decomposition of the lead peroxide. After heating the liquid is diluted with boiled water cooled down to the temperature of the room, and titrated with permanganate. A better process is to decompose a weighed quantity of the sample with a sufficiency of hydrochloric acid in a small flask fitted with a gas delivery tube. The chlorine gas given off is passed into solution of potassium iodide, and the iodine liberated is estimated in the known manner with sodium hyposulphite. The moisture of the samples is found by drying at 110°.

Valuation of Citric Acid.—J. Macagno neutralises with sodium carbonate, precipitates at a boil with calcium chloride, filters, concentrates the filtrate, and filters again hot, washing the deposit of calcium citrate with a little hot water. In old samples of lime-juice this process is untrustworthy, as fatty acids are formed by fermentation at the expense of the citric acid.

Analysis of Fats.—Nickels seeks to distinguish olive and cotton oils by means of the absorption-spectrum. E. Mylius points out that the absorption-bands belong not to olive oil as such, but to the chlorophyll dissolved in it, and are either very faint, or absent in the finest qualities. Crude cotton oil has the specific gravity 0.9303 at 16°, the

* This paper appears in our present issue, p. 66.—Ed. C. N.

refined oil 0.92647 at the same temperature (or according to Scheibe and De la Souchère, 0.923 at 17°), whilst olive oil is at 17° 0.915 to 0.916, or, according to Scheibe, 0.912. According to De la Souchère, cotton oil can be detected in mixtures by the more or less intense coffee-brown colour which the oil in question assumes when shaken up with an equal volume of nitric acid of specific gravity 1.37. According to Rödiger, cotton oil contains a non-saponifiable ingredient, which can be extracted by benzol from the dry soap in the form of golden yellow drops. For the detection of sesame oil in olive oil De la Souchère adds to a small piece of sugar hydrochloric acid of specific gravity 1.18. Equal quantities of this mixture and of the oil are shaken up together. The smallest quantities of sesame are betrayed by a red colouration.

New Method for the Analysis of Oils.—E. J. Mau-
mené.—From the *Comptes Rendus*.

Forms which Drops of Different Fats assume.—A.
Wynter Blyth.—From the *Analyst*.

**Determination of Neutral Fat, Palmitic and Oleic
Acids in Palm Oil.**—Fr. Sear.—From the *CHEMICAL
NEWS*.

**Determination of Undecomposed Fats in Mixtures
of Fatty Acids.**—O. Hausmann.—The author dissolves
5 grms. of the fatty acid mass in question in alcohol, adds
1 to 2 drops solution phenol-phthaleine, and titrates with
alcoholic normal alkali till a red colour appears. An ex-
cess of normal alkali may be added, and the mixture may
then be titrated back with normal oxalic acid till the red-
ness disappears. The number of c.c. of normal alkali
consumed may be, e.g., 17.0, which correspond to the
free fatty acid present. The weight of the latter, being a
mixture of stearic, palmitic, and oleic acid, cannot be
calculated until the molecular weight of the mixture is
established. For this purpose 5 grms. of the mass are
heated in the water-bath along with 25 c.c. of alcoholic
normal alkali until quite dissolved, thus saponifying the
neutral fat simultaneously with the free fatty acid. This
mixture is then titrated back with normal oxalic acid.
Assuming that 6.7 c.c. of the normal acid have been used,
18.3 c.c. of the normal alkali would have served for the
neutralisation of the free fatty acid and of neutral fat.
But 18.3 c.c. of normal alkali corresponds to 5 grms. of the
mixture of fatty acid; 1000 c.c. would represent 273.2
grms., which last number may be regarded as the molecu-
lar weight of the mixture. But 5 grms. of the mass re-
quire 17.0 c.c. of normal alkali, therefore they contain
 $17 \times 0.2732 = 4.644 = 92.8$ per cent fatty acid, and 7.2 per
cent neutral fat. The method is applicable to the deter-
mination of non-saponified fats in soaps.

Examination of Turkey-red Oil (Alizarin Oil).—L.
Brühl introduces a weighed quantity of the sample into a
graduated cylinder, and shakes it up first with dilute sul-
phuric acid and then with ether. The latter dissolves the
sulpho-ricinoleic acid, the weight of which is taken after
the evaporation of the ether.

Examination of Soda Soap.—Hope.—From the *CHE-
MICAL NEWS*.

Examination of Petroleum.—J. Schenkel.—A petro-
leum which gives off more than 5 per cent of volume
below 140°, and more than 10 per cent below 300°, is to be
rejected. The commercial value of petroleum is deter-
mined by the volume percentage which distil over between
145° and 300°. The petroleum which distils over between
these two limits is considered as normal petroleum.

Analysis of Explosive Ethers.—F. Hess.—Not suit-
able for abstraction.

**Analysis of Photographic Emulsions of Gelatine
and Collodion.**—J. M. Eder.—This memoir cannot be
usefully abridged.

Detection of Fusel Oil in Alcohol.—Hager dilutes
the alcohol, if containing more than 60 per cent of abso-

lute alcohol, with an equal volume of water, adds glyce-
rine, and lets evaporate upon filter-paper. After the
escape of the alcohol the fusel odour becomes distinct.
The author also gives instructions for the quantitative
determination of fusel oil.

Determination of Sugar.—F. Böckmann.—An account
of the methods of determination and conditions of sale
adopted in the French and Belgian beet-root works.

**Detection of Mineral Acids in presence of Organic
Acids.**—A. Jousien mixes in a dry test-tube a drop of the
essential oil of Dipterocarpus, with 25 drops of glacial
acetic acid. The mixture is colourless, and remains so on
the addition of any organic acid. But if a trace of a
mineral acid is present there appears a rose colour, which
passes into violet, and does not disappear on the addition
of 30 drops of alcohol.

**Determination of the Total Alkaloid in Cinchona
Barks or Cinchona Preparations.**—This paper requires
the accompanying figure.

The following analytical methods referring to physiology,
pathology, and forensic chemistry can be merely named:—

Determination of Magnesia in Urine by Titration.
—MM. Neubauer, Stolba, Kraus.

**Detection of Lead, Silver, and Mercury in the
Animal Body.**—Victor Lehmann.

Determination of Oxalic Acid in Urine.—F. Czapek.
Urines Coloured Red by Ferric Oxide.—B. Tollens
and R. v. Jaksch.

A New Pathological Urine Pigment.—E. Neusser.

**Detection and Determination of Arsenic in Organic
Masses.**—R. H. Chittenden and H. H. Donaldson.—
From the *American Chemical Journal*.

Reduction of Arsenious Acid or Arsen-Sulphide.—
C. Brame.—From the *Comptes Rendus*.

**The General Distribution of Copper in the Animal
and Vegetable Kingdoms.**—G. L. Ulex.

Detection of Phosphorus in Urine.—F. Selmi.—
From the *Moniteur Scientifique*.

The Infusoria as Physiological Tests for Poisons.
—N. J. Rossbach.

Detection of Spermatozoa.

Cosmos Les Mondes.

No. 2, January 13, 1883.

Colour of Distilled Water.—M. Meyer.—The author
takes a glass tube $7\frac{1}{2}$ metres long and 4 c.m. in diameter,
closed at each end by parallel planes of glass. This
apparatus is filled with distilled water, and placed hori-
zontally. On looking through it at a black ground by
daylight the colour appears intensely blue; by gaslight,
on the contrary, the colour is green.

The Atomic Weight of Lithium.—Dr. D. Tommasi.
—The atomic weight of lithium as deduced from its
principal compounds has been found=7, a value quite
in accord with the law of Dulong and Petit. The physical
and chemical properties of this metal having a certain
analogy with those of the alkaline metals, chemists have
not hesitated to place it in the same family with potassium
and sodium, and to regard it as a monovalent metal. If
it is true that free lithium resembles the alkaline metals
its compounds have no analogy with the salts of potassium
and sodium, but, on the contrary, approximate to the salts
of the bivalent, alkaline-earthly metals, and in particular
to those of magnesium. One of the most obvious
characters of the alkaline sulphates is to form alums with
aluminium sulphate, but lithium sulphate does not form
an alum. The alkaline sulphates can form bisulphates,
but lithium sulphate does not. The alkaline carbonates
are readily soluble in water, whilst lithium carbonate is
very sparingly soluble. Lithium chloride, unlike the

alkaline chlorides, is readily decomposed if heated in contact with air. The author, therefore, maintains that the atomic weight of lithium in its compounds is double that which it possesses in a free state. Hence he proposes for lithium chloride the formula Cl_2Li . He proposes to verify his theory by means of the law of Raoult, who has found that a molecule of any compound whatever, when dissolved in 100 mols. of any liquid whatever of a different nature, lowers the point of congelation by a quantity which is almost constant, and which approximates to 0.62° .

Currents produced by the Nitrates in Igneous Fusion in Contact with Carbon Heated to Redness.—M. Brard.—Already noticed.

Glass Coffins in Relation to Public Health.—Dr. A. Mayer.—The author proposes solid glass coffins, which, after the introduction of the corpse, are to be closed airtight with cement. Two apertures are provided, through one of which carbonic acid is introduced, whilst the atmospheric air escapes by the other. When the coffin is supposed to be filled these apertures are sealed up.

No. 3, January 20, 1883.

According to the *Journal d'Hygiène*, organic bodies may be preserved indefinitely by a galvano-plastic process. The objects are first steeped in an alcoholic solution of silver nitrate, wiped, exposed to hydrogen sulphide or phosphide, and then immersed in the ordinary galvano-plastic bath.

No. 4, January 27, 1883.

Illumination of Balloons.—For this purpose M. Mangin, member of the "Academy of Aerostation," uses an incandescent light immersed in a beaker of water.

MISCELLANEOUS.

Poggendorff's Biographical Literary Dictionary.—Dr. W. Feddersen has issued the following circular concerning the continuation of Poggendorff's Biographical Literary Dictionary:—

"Having been commissioned by the publisher, Mr. Johann Ambrosius Barth, of Leipzig, to continue and supplement the 'Poggendorff's Biographisch Literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften,' I now feel obliged—in consequence of a printed declaration, which shortly the publishing-house has sent to several scientists who were interested in the work—absolutely to withdraw from all connection with it. Should the publishing-house be able to find another competent editor, I will place at its disposal, without any compensation, for my labours all the answered blanks, notices, and papers which I have hitherto received, unless the authors of them otherwise order. My own manuscript, however, I do not feel at liberty to submit in this manner, no matter whether compensation is offered or not, because I do not know whether another will conduct the work as I would have desired to, or according to the plan I have hitherto pursued, and also because I do not wish to be held responsible for any injury which may result from this editorial change. In submitting this information to those interested, I beg leave to thank most sincerely all those gentlemen, both at home and abroad, who have assisted me up to the present time, and I wish especially to recognise most gratefully the numerous personal favours I have received in the conduct of the work.—Leipzig, January, 1883.

Glycerin in Beer.—Carl Amthor.—The greatest discrepancies prevail among accepted authorities as to the amount of glycerin naturally present in beer, the proportions stated ranging from 9 per cent to 0.005. According to the author's experiment the natural maximum is 0.3 per cent.—*Zeitschrift für Analytische Chemie*.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 12.—London Institution, 5.

Medical, 8.30.
Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field.

TUESDAY, 13th.—Royal Institution, 3. "Primæval Ancestors of Existing Vegetation," by Professor W. C. Williamson.

Institution of Civil Engineers, 8.
Royal Medical and Chirurgical, 8.30.
Photographic, 8. (Anniversary).

WEDNESDAY, 14th.—Society of Arts, 8. "The Society of Arts Patent Bill, and some Points in American Patent Law and Practice bearing thereon," by Sir Frederick Bramwell, F.R.S.

Microscopical, 8. (Anniversary).
Pharmaceutical, 8.

THURSDAY, 15th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.

London Institution, 7.
Royal, 4.30.
Philosophical Club, 6.30.
Chemical, 8. "On some Derivatives of Diphenylene-ketone Oxide," by A. G. Perkin.

FRIDAY, 16th.—Royal Institution, 8. "Anomalous Forms of Primæval Vegetation," by Prof. Williamson, at 9.

Geological, 8. (Anniversary).
Society of Arts, 8. "Overland Commercial Communication between India and China, via Assam," by Charles H. Lepper.

SATURDAY, 17th.—Royal Institution, 3. "Singing, Speaking, Stammering," by Dr. W. H. Stone.

FIRTH COLLEGE, SHEFFIELD.

The Council of Firth College, Sheffield, are prepared to appoint a Professor of Chemistry. The stipend will be £150 per annum, and half the fees of his own Department. Candidates are requested to give full particulars concerning age, experience, and any academical distinctions they may have gained. The names of three gentlemen to whom references may be made should be given, but no testimonials need be sent unless they are asked for. Applications to be sent in on or before March 1st.—Further particulars may be had from

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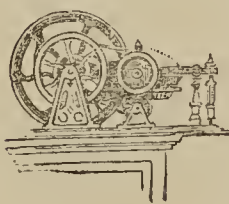
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1212.

ON THE DETERMINATION OF NITROGEN IN MIXTURES CONTAINING NITROGENOUS ORGANIC MATTER, AMMONIACAL SALTS, AND NITRATES.

By H. H. B. SHEPHERD, F.I.C., F.C.S.

THE presence of any considerable quantity of a nitrate in chemical manures and substances of a similar character, containing nitrogenous organic matter or ammoniacal salts, it is well known prevents the accurate estimation of nitrogen by the soda-lime process of Will and Varrentrap. The chief cause of failure is the disengagement of nitric acid from the nitrate, which affects the result by distilling over and increasing the quantity of acid originally placed in the nitrogen bulb, and also probably by a part combining with the free ammonia present in the combustion tube to form ammonium nitrate, which is immediately decomposed into nitrous oxide and water. The employment of copper turnings kept at a red-heat in the front of the tube will, it is true, prevent the passage of nitric acid into the nitrogen bulb, but even then an actual loss of nitrogen takes place, probably as nitrous oxide in the manner above indicated.

The quantity of hydrocarbonaceous matter present has also a direct bearing upon the result. The larger the quantity the higher will be the result obtained, owing to the reduction of a part of the nitrogen of the nitrate to ammonia. For this reason it sometimes happens that in testing a manure containing nitrogenous organic matter or ammoniacal salts or both together, as well as a nitrate, a correct determination of the organic or ammoniacal nitrogen will be accidentally obtained if much organic matter be present, since the gain on the one hand may exactly compensate for the loss on the other. But in such a case, if the determination be repeated, concordant results will not be obtained. Although this is perfectly well known, attention having been frequently directed to it, a few examples of actual results in illustration may not be out of place.

Mixture No. 1.

	Parts.	Nitrogen.
A sample of commercial sulphate of ammonia, containing 20·18 per cent nitrogen	20·41	= 4·11
Pure potassium nitrate	29·73	= 4·12
Phosphatic guano, containing 0·76 per cent nitrogen	49·86	= 0·38
	100·00	8·61

With this mixture, which consequently contained 4·49 per cent nitrogen derived from nitrogenous organic matter and ammoniacal salts, combustions with soda-lime were made in the usual way, with the following results:—

	Nitrogen pr. ct.
12-inch iron tube used; $\frac{1}{2}$ gramme sugar at the end; no copper turnings	4·27
14-inch iron tube used; $\frac{1}{2}$ gramme sugar at the end; 2 inches copper turnings in front	3·68
16-inch iron tube used; 2 grammes bicarbonate of soda at the end; 4 inches copper turnings in front	4·02
18-inch iron tube used; 2 grammes bicarbonate of soda at the end; 6 inches copper turnings in front	4·52
The same repeated	3·62

Mixture No. 2.

	Parts.	Nitrogen.
A sample of commercial sulphate of ammonia containing 20·18 per cent nitrogen	20	= 4·03
Pure potassium nitrate	40	= 5·54
Calcined gypsum	40	
	100	9·57

This gave the following results:—

	Nitrogen pr. ct.
18-inch iron tube used; 1 gramme oxalic acid at the end; 6 inches copper turnings in front	2·55
The same repeated	2·20
20-inch iron tube used; 1 gramme oxalic acid at the end, and a roll of copper gauze 8 inches long in front	2·68

A sample of an actual compound manure, containing 3·07 per cent organic and ammoniacal nitrogen, and in addition 3·03 per cent nitrogen in the form of sodium nitrate, on testing in the same way, using 6 inches of copper turnings, gave only 2·48 per cent. nitrogen, or a loss of over half per cent.

There can be no doubt that the want of a ready means for correctly estimating the nitrogen in mixtures containing organic or ammoniacal nitrogen and nitrates has hitherto largely hindered manure manufacturers from employing potassium or sodium nitrate in the composition of special manures, and attempts have been made by different chemists from time to time to devise a scheme to meet the difficulty and avoid resorting to Dumas' method of combustion with copper oxide.

A process that has been used to some extent on the Continent consists in simply adding a quantity of starch or sugar to the substance for analysis before the combustion with soda-lime, so as to effect the reduction of the nitric nitrogen to ammonia; but it has been repeatedly shown that the reduction by this means is very far from complete, and consecutive determinations made with the same substance will be found to vary considerably.

In the CHEMICAL NEWS, vol. xxv., page 205, B. J. Grosjean suggested the following plan:—

Determine the nitric and ammoniacal nitrogen by decomposing with aluminium or iron, and solution of caustic soda in the apparatus recommended by Vernon Harcourt for nitrates. Carry on the distillation until the contents of the retort become pasty, and submit the residue to combustion with soda-lime. To obviate the difficulty of removing the residue from the retort, he further proposed to treat an equal quantity of the substance in a beaker in a similar way, carrying on the evaporation to the same point and at the same temperature as in the retort. The nitrogen obtained by combustion of the residue with soda-lime, added to that furnished by the distillation, will then give the total nitrogen.

Another plan is to expel the nitric acid contained in the substance for analysis by evaporation with sulphuric acid, and determine the nitrogen in the residue. If the percentage of nitric acid is also required a separate determination can be made in a fresh portion of the original substance.

Ruffle's Method.—A method for determining nitrogen, including the nitro-compounds, in one operation, was published by J. Ruffle in a paper communicated to the Chemical Society ("On the Estimation of Nitrogen by Combustion, including the Nitro-compounds;" *Journ. Chem. Soc.*, vol. xxxix., p. 87). This method depends, as is well known, upon the reduction of the nitro-compounds by sodium thiosulphate—the so-called hyposulphite of soda—in presence of sodic hydrate. To proceed according to Mr. Ruffle's directions there are required, besides the usual materials for performing combustions with soda-lime,—

- (1.) A mixture of wood charcoal and sulphur in equal proportions.
- (2.) A special soda-lime prepared by dissolving 160 grms. of sodic hydrate in 160 c.c. of hot water, and stirring in 56 grms. of finely-powdered lime obtained from marble. The mass to be then thoroughly dried and powdered.
- (3.) Some common hyposulphite of soda.
- (4.) Iron combustion-tubes 22 inches long and $\frac{3}{8}$ inch internal diameter.

The process is conducted as follows:—

From 1 to $1\frac{1}{2}$ grms. of the substance to be analysed is first mixed with $1\frac{1}{2}$ grms. of the charcoal and sulphur mixture. 21 grms. of hyposulphite are crushed in a mortar, 18 grms. of the special soda-lime added, and the two well intermixed. About 5 grms. of this mixture are first passed through a funnel into the combustion-tube; then about 30 grms. of the mixture are placed in the funnel, the substance for analysis, as previously prepared, quickly mixed with it, and the whole dropped into the tube. The remaining 4 grms. of the mixture of hyposulphite and soda-lime are next poured in, followed by 18 grms. of ordinary soda-lime. Finally, the customary plug of asbestos is inserted, the bulb containing the standard acid attached, and the combustion conducted in the usual way.

As this process appeared to be a very promising one, the following experiments were undertaken to ascertain how far Mr. Ruffle's results could be corroborated:—

It was found, in the first place, that a blank experiment, *i.e.*, without any substance for analysis, gave a small but by no means insignificant quantity of nitrogen, derived partly perhaps from the charcoal, but chiefly from a trace of nitrate in the soda used for making the soda-lime. It is important to be on one's guard against this source of error, since the presence of 1-10th per cent of sodium nitrate in the caustic soda used for making the special soda-lime would yield sufficient nitrogen to introduce an error of 0.2 per cent in the results if 1 gram. of substance were taken, and this is omitting any consideration of the ordinary soda-lime used for the front part of the tube. Practically it will be found that nearly all commercial caustic soda contains a trace of nitrate, due to a slight excess being used in the process of nitrating for the destruction of sulphides, &c., in its manufacture. Caustic soda free from nitrate may, however, easily be obtained by causticising pure carbonate, or soda made from sodium may be used, but in any case a blank experiment should be made before proceeding with an actual determination. In the following experiments the error was ascertained in this way, and the amount deducted from each determination:—

The following are some results that were obtained:—

Pure ammonium sulphate containing 21.21 per cent nitrogen—

Percentage of Nitrogen found.

21.15

21.20

A sample of Peruvian guano free from nitric nitrogen—

	Nitrogen per cent.
Determined by ordinary soda-lime process	11.38
„ „ Ruffle's process	11.38

A sample of Australian phosphatic guano—

Determined by ordinary soda-lime process	0.76
„ „ Ruffle's process	0.80

Pure potassium nitrate containing 13.85 per cent nitrogen—

Percentage of Nitrogen obtained.	Calculated as Percentage of the Total Nitrogen present.
13.54	97.76
13.35	96.39
13.21	95.37
13.34	96.31
13.18	95.16

Pure sodium nitrate containing 16.47 per cent nitrogen—

15.85	96.23
16.11	97.81
16.00	97.14
15.73	95.50

It is much to be regretted that the experiments with potassium and sodium nitrate did not yield entirely accurate results; still, it must be remembered that manures very rarely indeed contain more than 4 or 5 per cent nitric nitrogen, and the nitrogen in other combinations is determined in full by Ruffle's method.

A drawback to the use of this process is the difficulty of cleaning out the iron tubes. Mr. Ruffle recommends the following plan. Remove the asbestos plug whilst the tube is still hot, and pass an iron rod (previously heated) down to the end, then withdraw it, and insert again, repeating this several times while the tube is cooling. When cold, pour in warm water, and agitate by drawing the iron rod up and down, by which means the tube can be washed clean. Though this will answer, it is a little tedious, and a quicker plan is to fix the tube, when cold, in a vice, and drill out the contents with a drill the length of the tube.

While speaking of the Ruffle process it is as well to caution anyone using it for the first time to be careful to place the tube in the furnace either in a perfectly horizontal position, or with the front slightly elevated. If this precaution is not observed the fused mass inside will gradually flow towards the front, completely blocking it, and an explosion will be inevitable.

Determination of Nitric Acid in Manures.

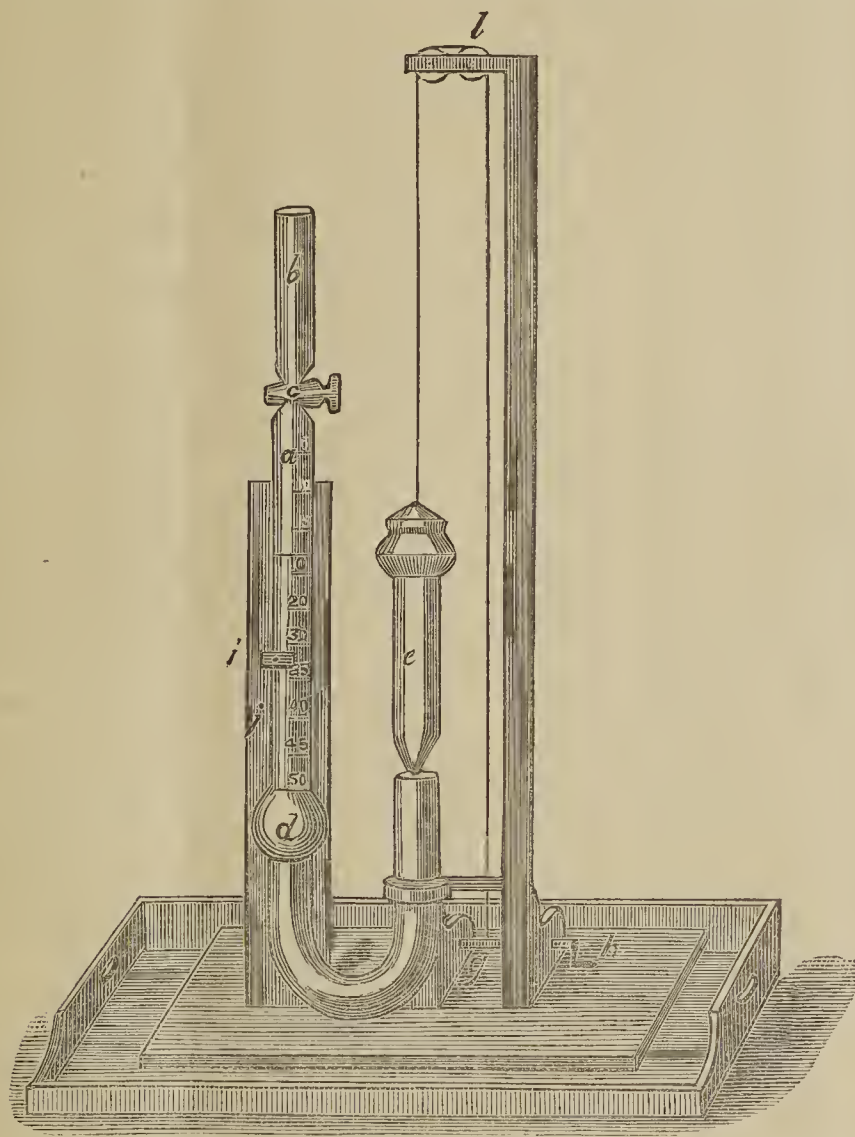
For the determination of nitric acid in manures, the Crum and the indigo methods are both well adapted. When the quantity of nitric nitrogen present is small the indigo method can be made to yield excellent results, but in cases where a large amount is present it is better to resort to the Crum method. This method, indeed, answers admirably in all cases, leaving little or nothing to be desired.

The Crum Method.—The accompanying sketch shows a form of nitrometer and stand suitable for working Crum's method.

The cylindrical part of the nitrometer, *a*, has a capacity of 50 c.c., and is graduated in its entire length into 500 divisions. At the top is a cup, *b*, and between the cup and the cylindrical part an ordinary single-way stopcock, *c*. At the lower end is a bulb, *d*. The nitrometer is connected by means of a piece of stout caoutchouc pressure tubing with a levelling tube or reservoir, *e*. The levelling tube is hung by a cord, which passes over the pulley, *f*, and is fastened to the switch, *g*, so that by turning the handle, *h*, it can be raised or lowered. The button, *i*, serves to hold the nitrometer in its place in a recess made to fit it in the upright support, *j*. In making a determination the quantity of substance to be taken must be regulated by the amount of nitric nitrogen supposed to be present. Of substances containing as much as 5 per cent not more than 0.2 gram. should be taken, whilst of substances containing less than 1 per cent, 2 or 3 grms. will be found a convenient quantity. The weighed portion is to be extracted with boiling water and filtered, the filtrate and washings evaporated to a small bulk and passed into the nitrometer. (The removal of chlorine by silver sulphate is unnecessary.) The fluid must be kept as concentrated as possible, and including the rinsings of the evaporating basin should not exceed 5 c.c. After cooling, twice its volume of pure oil of vitriol is to be cautiously run in, and the nitrometer removed from its receptacle, and very gently shaken once or twice to mix the fluids. Usually some carbonic acid and other gases are given off, which must be allowed to escape before proceeding, by raising the levelling tube and opening the stopcock for an instant. The nitrometer is then to be very vigorously

shaken, which soon causes the evolution of nitric oxide to commence, and in a few minutes the reaction is complete. The nitrometer is then replaced and allowed to cool to the temperature of the room, the pressure equalised by raising or lowering the levelling tube and the volume of gas read off. The weight of the column of acid in the nitrometer may be compensated for with sufficient accuracy by raising the level of the mercury in the levelling tube above that in the nitrometer, about 1° for every 8° occupied by the acid—the proportion indicated by the specific gravity of the acid compared with that of mercury. (*Vide* paper by Lunge "On the Analysis of Saltpetre by the Nitrometer," *Journ. Soc. Chem. Industry*, vol. i., No. 1.) Before calculating the correction for atmospheric pressure and temperature the precaution should be taken to test

a beaker, add 20 c.c. of water, and run in a little of the indigo from a burette; then add 50 c.c. of strong oil of vitriol, stir gently, and observe the temperature, which should rise to about 130° C. It is convenient for this purpose to use a thermometer for a stirring rod. Now quickly run in more indigo until the change of colour indicates an excess. One of the chief peculiarities of the process is that the *maximum* amount of indigo is decolourised only when it is *all* present before the addition of the oil of vitriol. (*Vide* Warrington's papers "On the Determination of Nitric Acid by Indigo," *CHEMICAL NEWS*, vol. xxv., pp. 45 and 57; *Journ. Chem. Soc.*, xxxv., 578). The result obtained by the first experiment will probably, therefore, be far short of the actual amount of indigo required. A second trial must now be made by taking 5 c.c.



the purity of the nitric oxide by passing a warm solution of ferrous sulphate into the nitrometer, and observing if the whole of the gas is absorbed.

The Indigo Method.—The following is a brief account of the mode of working the indigo method for the analysis of manures. A standard solution of potassium nitrate is first prepared by dissolving 1·1895 grms. of the pure dry salt in a litre of water. 5 c.c. of this solution will consequently contain 0·00594 grm. potassium nitrate, or 0·003176 grm. nitric anhydride, or 0·000823 grm. nitrogen. The indigo used is either a weak solution of indigo carmine acidified with sulphuric acid, or a solution of indigotine in sulphuric acid. If indigo carmine is used, 10 grms. may be dissolved in 5 litres of water, and the solution afterwards adjusted so that 15 c.c. shall correspond to 5 c.c. of the potassium nitrate solution. The solution does not keep well, but undergoes less change if preserved from the light. To standardise it proceed as follows:—Place 5 c.c. of the potassium nitrate solution in

of the potassium nitrate solution as before, adding 20 c.c. of water, and running in *before the addition of the acid* the full quantity of indigo decolourised in the first experiment. On the addition of the 50 c.c. of acid, the colour will now entirely disappear, a further quantity of indigo being required to produce an excess. On making a third trial, running in, before the addition of the acid, the full quantity of indigo taken in the second experiment, a little more still will probably be required, and this procedure must be repeated until the maximum amount of indigo capable of being decolourised is ascertained. The following notes of an actual case will make this clear:—

5 c.c. potassium nitrate solution taken, and 20 c.c. water—
1st expt. Indigo ran in at first 5 c.c. Total indigo required

					8 c.c.
2nd	"	"	"	8	" 13·9 "
3rd	"	"	"	13·9	" 14·5 "
4th	"	"	"	14·5	" 14·7 "
5th	"	"	"	14·7	" 14·7 "

On repeating the last-mentioned experiment several times, a mean result of 14.74 as the maximum amount of indigo required was obtained.

Several trials were then made with 10 c.c. potassium nitrate solution and 15 c.c. water, which gave a mean result of 29.45 c.c. indigo required. Therefore, since 14.74 c.c. corresponded to 5 c.c. potassium nitrate solution containing 0.000823 grm. nitrogen, each c.c. = 0.000558 grm. nitrogen.

In testing a manure, digest 2.5 grms. in 250 c.c. water, with the addition of about 2 grms. of alum (to precipitate the organic matter). Filter and proceed exactly in the same manner as in standardising. The quantity of water to be added should be proportioned in such a way that the quantity of solution taken + water added + indigo used shall always amount to about the same volume.

The following results were obtained by the indigo method worked in this way:—

	Nitric Nitrogen by calculation.	Nitric Nitrogen found.
100 parts phosphatic guano ..	..	..
2.5 „ pure potassium nitrate ..	0.32	0.36
2.5 „ ammonium sulphate ..	..	..
34 „ Peruvian guano free from N ₂ O ₅	3.05	3.13
10 „ sodium nitrate .. ..	..	..
10 „ calcined gypsum ..	..	..

Determinations of nitric nitrogen in samples of Peruvian guano:—

	Percentage of Nitric Nitrogen found by the	
	Crum Method.	Indigo Method.
1.	0.19	0.19
2.	0.093	0.10
3.	0.65	0.66
4.	0.27	0.27

The following results will show the use of Ruffie's method for total nitrogen in conjunction with nitric acid determinations:—

	Total Nitrogen by calculation.	Total Nitrogen found by Ruffie's Method.	Nitric Nitrogen by calculation.	Nitric Nitrogen found by Crum's Method.
Commercial sulphate of ammonia with 20.18 per cent nitrogen	20.41	8.61	8.47	4.12
Pure potassium nitrate	29.73			
Phosphatic guano with 0.76 per cent nitrogen ..	49.86			
	100.00			
Pure sulphate of ammonia	2.5	1.55	1.55	0.32
Pure potassium nitrate	2.5			
Phosphatic guano with 0.76 per cent nitrogen ..	100.0			
	105.0			
Commercial sulphate of ammonia with 20.18 per cent nitrogen	20	9.57	9.44	5.54
Pure potassium nitrate	40			
Calcined gypsum	40			
	100			
Pure sulphate of ammonia	20	7.53	7.37	3.29
Pure sodium nitrate	20			
Mineral superphosphate	60			
	100			

In conclusion, the writer has much pleasure in expressing his thanks to Dr. Voelcker and Mr. Bernard Dyer for the help they have accorded him in preparing this paper.

Messrs. Ohlendorff and Co.'s Manure Works,
Victoria Docks, London, E.

PYROLOGICAL NOTES.

By Lieut.-Colonel W. A. ROSS, F.G.S., late R.A.


(Continued from p. 4)

X. BORIC ACID AND ALUMINIUM PLATE (*Continued*).

A. Does all Silica Consist of Two Compounds?

N.B.—BEFORE commencing the subject of this paper, I take the opportunity of mentioning that, having sent a "pebble" of calcium borate (made as described in Note IX.) to Mr. Wenham, the well-known microscopist, with a view to the possible use of this substance for object glasses of microscopes, he kindly informed me that it possesses a very high index of refraction, equal, if I remember right, to that of sapphire. As, if properly made, calcium borate undergoes no alteration in any climate, and can be moulded, when hot, into any shape, taking even a higher polish than the best glass, it might be worth the while of microscopists to look into this matter.

It was stated in Note IX., that siliceous calcium borate changes weight on being re-treated in boric acid, and, if the inference—apparently the only inference—to be drawn from this phenomenon be correct, the experiment I am now about to describe seems to have scarcely a parallel in the ordinary history of chemical analysis, for simplicity of detail, combined with theoretical, and probably practical, importance of results. It is to be performed as follows:—

(1.) The operator takes up a ball or mass of pure calcium borate on a hook (not a ring as usual) of thin new platinum wire, about this shape , and twice this size, which is as nearly as possible red-hot. It may be previously ascertained, if he doubts the fact, but I have often proved it, that this calcium borate ball is unchanged as to weight by re-treatment before the blowpipe, in any number of fresh beads of pure boric acid, to none of which it contributes the slightest opalescence. He now, gently and carefully, fuses or dissolves in this calcium borate, so supported, a weighed amount of the purest chemically-prepared and dried silica he can obtain, or of pure powdered rock-crystal, before the blowpipe.

(2.) When the silica is completely and transparently dissolved by O.P., the siliceous calcium borate is run off the wire while it is red-hot on to a clean tray of aluminium, by inclining the wire upwards at first, so that the ball may slide, while hot, off the hooked part on to the shank of the wire. The hooked part is then carefully straightened, when cool, with clean forceps, and the now straight wire, with the ball upon it, held perpendicularly downwards over the aluminium tray, when a little O.P., pointed slightly above it, soon runs the ball off the wire into the tray, and it is then carefully weighed, when quite cold, in an assay balance.

(3.) The siliciferous calcium borate is now taken upon a hot bead of pure boric acid, into which it soon sinks, and treated there with O.P., when—and this is the most curious part of the reactions—a grey opaline matter is copiously evolved from the siliceous ball into the clear bead, before long rendering the latter opaque; and this opalescent emission evidently takes place during the formation of the inner balls.

(4.) The opaque bead containing the siliciferous ball with its transparent inner balls is now placed, wire and all, in a platinum capsule of distilled water, and boiled, when in a few seconds the soluble opaque bead is dissolved, and the insoluble calcium borate ball containing the silicon borate balls (if such they be according to

Note IX.) extracted, and applied as before, to a fresh bead of pure boric acid under O.P.

Opalescent matter is again evolved from the siliciferous ball into the fresh bead, until it, too, is rendered opaque, and more inner balls formed; and this double phenomenon of opalescence-evolved and inner-ball formation is continued in proportion to the quantity of silica originally dissolved in the calcium borate. I found in my experiments of 1880 that 5 m.grms. of silica would thus render some three or four beads of boric acid nearly opaque. The most extraordinary circumstance is that, when the siliciferous calcium borate—or, as it may now be termed, the “balls-containing-ball”—is extracted by boiling from the last bead of boric acid, and weighed, it is found, notwithstanding the loss of all this opalescent matter, to have *very much increased in weight*.

Here, then, I submit, we have a beautiful illustration of the ordinary theory of CHEMICAL EXCHANGE. “Pure” silica contains “something” in combination, of almost infinitesimal weight, but in very considerable proportion, which, under the pressure of attraction or other influence, of anhydrous calcium borate before the blowpipe, is *exchanged* by it for heavier boric acid, passed on from the outer bead through the calcium borate ball.

It may be asked by my readers: “What proof have you got that this opalescent matter is not an actual part of the silica in a soluble state?” (as I long supposed it to be), and, if so, I answer—this proof: Led by my doubts on this very point, I applied 5 m.grms. of pure silica, prepared at Görlitz, in Prussia, to a boric acid bead by itself, in the first instance, before the blowpipe, where, of course, it was utterly unattacked and unaltered in weight or condition. I then applied to this silica-containing-bead a weighed ball of anhydrous calcium borate under O.P., when grey opaline matter was immediately evolved by the silica, until the whole bead became opaque. The opaque bead was then boiled, the calcium borate ball extracted and weighed, and the residual silica (washed with boiling distilled water) dried in the platinum basin, and also weighed. This operation was repeated until the bead was no longer opalescent. The calcium borate ball was precisely the same weight as before, but the silica now only weighed 2 m.grms., and, placed under the $\frac{1}{4}$ -inch objective of a microscope alongside some ordinary silica on the same slide, exhibited, apparently, quite different optical properties. This quantitative experiment was several times repeated with a like result.

I shall reserve for another paper the consideration of the questions: (a) What this opalescent matter derived from pure silica may be supposed or proved to be; and (b) What I conceive to be the *rationale* of the phenomenon.

B. Carbon-backed Tongs for Aluminium Plate.

There is but one advantage in the use of charcoal as a support for volatile metals before the blowpipe not possessed by aluminium plate in its present form, which defect on the part of aluminium, I propose to remedy as follows:—

Sublimates deposited on charcoal can, in some cases (as, *e.g.*, antimony), be distinguished by the fleeting but distinct coloured flame or pyrochrome which they afford in the blowpipe H.P. (or R.F.) applied to the charcoal. This is not the case when they are deposited on aluminium plate, because they cannot there be deoxidised and reduced to the metallic state in which pyrochromes are afforded, so perfectly or rapidly by the blowpipe pyrocone as they can when coating charcoal. The operator, however, can easily produce this result, in addition to the many advantages of aluminium not possessed by charcoal, by cutting or sawing a thin slice of charcoal off the parallelpiped^s in which it is usually sold, and fastening this slice, with thin iron wire, broad side up, on one of the legs of the iron forceps by which aluminium plate is ordinarily held. He thus obtains a black (charcoal) surface in immediate local contradistinction to a white (aluminium) surface, both of which simultaneously receive parts of the same pyrochrome or

coating, and their differing reactions before the blowpipe may be thus almost simultaneously compared.

ON THE PRESENT CONDITION OF THE SODA INDUSTRY.*

By WALTER WELDON, F.R.S.,
Chevalier de la Légion d'Honneur.

(Continued from p. 69).

RETURNING to the ammonia process, when that process first began to threaten them, the makers of Leblanc soda comforted themselves by two considerations: one of which was that the ammonia process must itself tend to check its own extension, by reason of the loss of ammonia inseparable from that process so increasing the demand for ammonia as to materially raise the price of that body. They knew that the constantly increasing demand for ammonia for the purposes for which it was already employed had doubled its price within twenty years; and they thought that every further extension of the ammonia-soda process must still further increase the market-value of ammonia, until at length the ammonia process would cease to have any advantage over the Leblanc process. So far, however, from that anticipation having been realised, despite the immense extension which the ammonia-soda process has recently undergone, the price of ammonia is now beginning to fall. The delusion that it was impossible to collect the ammonia given off from coke-ovens without spoiling the coke is at last giving way before accomplished facts; ammonia is now being obtained commercially not only from coke-ovens, but also from another source, wholly unforeseen and unexpected; and the time, moreover, seems at last to have dawned when there will be collected and utilised as ammonia at least a portion of the nitrogen of nearly all the fuel burnt either for industrial or for domestic purposes.

In France, ammonia has been collected from coke-ovens for a number of years past.† It is fully ten or twelve years since M. Carvés said to French coke-manufacturers: “I wish you to try my system of making coke, but I do not ask you to risk one farthing in doing so. If you will permit me, I will build coke-ovens in your works at my own expense. I will guarantee you against all risk of the coke produced being of inferior quality; so that, if I fail, you shall be no loser. If I succeed, I will ask you for no money royalty, nor will I ask you to pay me for the coke-ovens: I will only ask that you shall give me for a short term of years one-third of those products which I shall condense, but which, at present, you do not condense.” This offer was accepted by some of those to whom it was addressed, with results quite satisfactory both to them and to M. Carvés. Quite recently, coke-ovens on the Carvés system have been erected in South Durham, and about three months ago ammonia from them began to appear in the market.

This fact, however, is not nearly so important as something which has been done simultaneously in North Durham. While the Carvés system of making coke gives important results, it has the disadvantage of requiring coke-ovens of a special construction. It could thus extend only in proportion as the existing coke-ovens were

* A Paper read before the London Section of the Society of Chemical Industry, at the Chemical Society's Rooms, Burlington House, London, Monday, January 8, 1883, by the Chairman of the Section.

† Not, however, I find, to any considerable extent. The only system of collecting ammonia from coke-ovens which is in use in France is the Carvés system, and that is in use only in three works: at Tamaris, at Terre Noire, and at Bességes. The total quantity of coke produced in Carvés ovens in France is 300 tons per day, and the total quantity of volatile products condensed from these ovens per day consists of six tons of tar and ammonia equal to from two to two and a half tons of ammonium sulphate. The coal used in the works in question is much less nitrogenous than ordinary English coal.

replaced by new ones; and replacement of the present ovens by Carvès ovens would naturally be a slow process. For a method of collecting ammonia and other volatile products from coke-ovens to obtain wide application rapidly, it must be a method applicable to existing coke-ovens; and a method applicable to existing coke-ovens, at a very slight expense, has been recently devised by an English inventor, Mr. John Jameson, of Newcastle-on-Tyne. His method has now been in operation for nearly six months at the works of our vice-president, Mr. Hugh Lee Pattinson, at Felling, near Gateshead: and Mr. Pattinson authorises me to state that he has "reason to be abundantly satisfied with the results." The products condensed are the products of the distillation of coal at a very low temperature. They include, per ton of Northumberland steam coal operated upon, an average of eleven gallons of oil, and ammonia equal to twelve pounds of ammonium sulphate. The oil is a crude paraffin oil, of 0.9 specific gravity, containing from 8 to 10 per cent, according to the coal employed, of solid paraffin. The yield of oil will probably not be greatly increased; but it is expected that the yield of ammonia, the appliances for collecting which at Felling have hitherto been imperfect, will be increased considerably. There is also obtained, per ton of coal treated, from 12,000 to 15,000 cubic feet of combustible gases. The coke obtained is fully equal, both in quantity and in quality, to that obtained by coking the same kind of coal in the ordinary way. The cost of applying the system to existing coke-ovens does not exceed £30 per oven. Licences for applying it to 100,000 tons of coal per annum have already been applied for, and there is every prospect that its application will extend very rapidly.

While during these last few months ammonia has thus begun to be collected from English coke-ovens, it has also begun to be collected from Scotch blast-furnaces. In Scotland, there are some 120 blast-furnaces which are worked with raw coal. Recently, a member of the firm of William Baird and Co., who happens to be also a director of a gas-work, Mr. Andrew K. McCosh, was struck by the idea that the methods employed for separating ammonia and tar from crude illuminating gas might be used for separating the same bodies from the gases from blast-furnaces in which raw coal is used; and although the volume of gases from such furnaces, per ton of coal employed, is about thirteen times greater than that of the gases obtained by distilling the same kind of coal in retorts,—is not less, that is to say, than 130,000 cubic feet,—this idea has been put into execution with complete success. From two of the sixteen blast-furnaces at the Gartsherrie Ironworks ammonia and tar have been regularly collected for some months past, and preparations are in progress for collecting them from the other fourteen blast-furnaces there. The quantity of ammonia at present being obtained at Gartsherrie is the quantity corresponding to about 18 cwt. of ammonium sulphate per day, being at the rate of 20 lb. of ammonium sulphate per ton of coal consumed. The other products condensed from the blast-furnace gases have more resemblance to ordinary gas tar than the corresponding products obtained from the Felling coke-ovens. They are products of the distillation of coal at a temperature intermediate between the temperature at which distillation goes on in those coke-ovens and the temperature at which it is performed in gasworks; and, though the value of the blast-furnace tar has not yet been fully ascertained, it is believed to be nearly as valuable as ordinary gas-tar, though not quite. The results thus obtained at Gartsherrie have led to endeavours at other Scotch ironworks to accomplish the same object in other ways; and experiments to this end are in progress at the Monkland ironworks, the Summerlee Ironworks, the Ardeer Ironworks, and others; so that we may fairly expect that the time is not far distant when all the ammonia and all the tar which are evolved from Scotch blast-furnaces will be collected and sent into the market.

Each of these 120 Scotch blast-furnaces consumes, on

an average, 50 tons of coal per twenty-four hours. The total quantity of coal consumed in them per annum is thus $50 \times 120 \times 365 = 2,190,000$ tons. The quantity of ammonia yielded per ton of coal being, as I have said, the quantity corresponding to 20 lbs. of ammonium sulphate, there can thus be obtained per annum from these 120 blast-furnaces a quantity of ammonia corresponding to nearly 20,000 tons of ammonium sulphate, worth, at the present selling price of that commodity, not less than £400,000.

Large, however, as is this quantity, it is only one-tenth of the further quantity which can be obtained from English coke-ovens. The quantity of coal coked annually in England is not far short of 20,000,000 tons, and if Mr. Jameson's system were applied to the whole of our coke-ovens, with the result of collecting, per ton of coal treated, the same quantity of ammonia as is obtained from the Gartsherrie blast-furnaces, there would be obtained from this source per annum the quantity of ammonia corresponding to 180,000 tons of ammonium sulphate, at present worth more than three and a half millions sterling. Nor is even this all; for I shall have to speak in a moment of another possible, and I believe probable, source of ammonia, even more extensive still.

Now, of the ammonia employed by the ammonia-soda maker, he loses from one-fiftieth to one-fortieth part. As he has to employ from one and a half to one and three-quarter equivalents of ammonia for each equivalent of sodium carbonate finally obtained, we may take it that he loses about one twenty-third of an equivalent of ammonia for each equivalent of sodium carbonate manufactured. In terms of ammonium sulphate, being the terms in which the loss of ammonia in the ammonia-soda process is usually stated, this loss corresponds to about five and a half parts of ammonium sulphate per hundred parts of sodium carbonate produced. The total annual loss of ammonia in the manufacture of the 163,000 tons of ammonia-soda now being produced per annum thus corresponds to just about 9000 tons of ammonium sulphate. This is, no doubt, a large quantity of a commodity worth £20 per ton; but, in comparison with the extent of the new sources of ammonia which have just begun to be turned to account, it is utterly insignificant. It is less than one-twentieth part of the quantity capable of being yielded by blast-furnaces and coke-ovens in Great Britain alone, and is a smaller fraction still of the quantity which, I believe, can be obtained from another source which has yet to be mentioned. We may, therefore, be quite certain that the progress of the ammonia-soda process will not be hindered or limited by any difficulty as regards supply of ammonia.

The other consideration to which I referred as having given comfort to the makers of Leblanc soda, and which constituted indeed their chief ground of hope for salvation against the ammonia process, was that the world requires chlorine as well as soda, and that while the chlorine of the salt decomposed by the Leblanc process is yielded as hydrochloric acid, from which free chlorine can be obtained readily, the chlorine of the salt decomposed by the ammonia process is yielded as a somewhat dilute solution of calcium chloride. It was thought that the ammonia process would eventually even help the existing Leblanc soda-makers, by preventing the further extension of the Leblanc process, and so increasing the production of hydrochloric acid, and thereby at length increasing the value of that body. The ammonia process, no doubt, would have produced that result, and would have produced it by this time, if the supply of hydrochloric acid in this country had not been already so largely in excess of the demand for chlorine products. That demand is always becoming larger, and within the last few years the production of hydrochloric acid has appreciably diminished; but in this country the constantly-increasing stringency of legislative enactments with respect to river and air pollution has compelled so many producers of hydrochloric acid, who would have preferred to throw their acid away,

to employ it in the manufacture of chlorine, whether that manufacture were profitable or not, that the selling price of chlorine products has of late years been continually falling, until it is now at a point at which it barely pays their cost. No doubt, if all the other conditions of the problem were to remain as at present, the demand for chlorine products would in time overtake the supply of hydrochloric acid in this country, as it has long since done on the Continent, and the manufacture of chlorine in England would so again become profitable. But the other conditions of the problem are not likely to remain stationary, and both M. Solvay and myself are doing our best to change them.

M. Solvay is proposing to manufacture hydrochloric acid from the residual calcium chloride of the ammonia process. I imagine that he is urged to that course, not merely by a desire to turn that calcium chloride to account, but also by a desire to avoid making too much nuisance. For it must not be supposed that even the ammonia process, when practised on a large scale, is free from nuisance. It certainly does not send into the air any noxious vapours, but it sends into the water-courses very large quantities of calcium chloride, rarely accompanied by less, and often accompanied by much more, than an equivalent quantity of sodium chloride, and very apt to be accompanied also by both calcium carbonate and free lime. Neither calcium chloride nor sodium chloride will do much harm to a river, if sent into it in moderate quantities; but when it comes to sending into a comparatively small stream, far inland, 260 tons of calcium and sodium chlorides per twenty-four hours,—say, about ten tons per hour, night and day, all the year through: and M. Solvay must be doing something very like that at Dombasle,—the matter assumes quite another aspect. I am not myself an angler, but, if I were, I do not think that I should seek for sport immediately below Dombasle.

Be all that, however, as it may, M. Solvay is now erecting at Dombasle apparatus for an industrial trial of a process for obtaining hydrochloric acid from calcium chloride, at which he has been working for many years. The process in question consists in first concentrating by evaporation the mixed solution of calcium and sodium chlorides which is the residual product of the ammonia process; then mixing the concentrated solution with clay, making the mixture into balls and drying those balls; and then heating these balls to redness in a current of steam. This process certainly works, on condition that the temperature employed be sufficiently high, and that the quantity of steam used be largely in excess of the quantity necessary to react upon the calcium chloride. As the resulting mixture of vapour of water and vapour of hydrochloric acid would otherwise give an extremely dilute aqueous acid, M. Solvay proposes to separate from it most of its vapour of water, before condensing its hydrochloric acid, by passing the mixture of the two vapours through a very strong solution of CaCl_2 , which he finds will absorb most of the steam from such a mixture, allowing the HCl to pass on alone, so that it can afterwards be condensed in the usual way. All this is ingenious, but it can hardly be cheap. Firstly, a solution containing only about eight per cent of calcium chloride has to be evaporated, we may say to dryness; then the mixture of CaCl_2 and clay has to be maintained at a red heat for a considerable time, in a current of steam; and then the solution of calcium chloride used to separate steam from the resulting mixture of steam and HCl has to be prepared for use again by having all the water which it has absorbed evaporated off from it. To English manufacturers who have more hydrochloric acid than they can use, this process of M. Solvay's will seem little less than ridiculous; but one must remember that it is intended for countries in which the demand for hydrochloric acid exceeds the supply, and in which countries, moreover, chlorine products are protected by import duties. In such countries, one can quite conceive its being commercially practicable; in which case the exportation of chlorine products from England to

the Continent is doomed. I ought to add that M. Solvay expects that the silico-aluminate of calcium which remains after the chlorine of his mixture of calcium chloride and clay has been driven off by steam will be useful as a cement, and will thus help to pay the cost of his hydrochloric acid.

The exportation of chlorine products from England to the Continent is, moreover, threatened in another way. The Continental manufacturers of Leblanc soda, unlike the English manufacturers of Leblanc soda, do not produce enough hydrochloric acid to meet the demand of their respective countries for that acid itself and the products which are made from it. This is partly due to the production of ammonia soda, proportionately to the total production of soda, being so much greater in France and Germany than in this country, and partly to hydrochloric acid being required in those countries for industries which in this country do not exist. Large quantities of chlorine products consequently go to the Continent from this country; our production of hydrochloric acid being still sufficient to enable us to supply not only the total English demand for chlorine, and the total American demand for chlorine, but also an appreciable proportion of the Continental demand for chlorine, and, in addition to all that, to throw a large residue of hydrochloric acid into the North Sea. The Continental Leblanc soda-makers do not like this importation into their respective countries of chlorine products from England; but they can prevent it only in one or other of two ways: either by increasing their production of hydrochloric acid, or by becoming enabled to obtain from a given quantity of hydrochloric acid a larger proportion of free chlorine than is yielded by the process at present in use. Personally, I have for the process at present in use that respect which one always feels for the bridge which has carried one over, but I am well aware that it can by no means be regarded as final. It yields chlorine cheaply; but it yields only one-third of the total chlorine contained in the acid employed, the other two-thirds being lost as calcium chloride. English chlorine manufacturers will regard almost with horror the idea of a new chlorine process, which shall yield in the free state practically the whole of the chlorine contained in the acid employed; but on the Continent there is a demand for such a process,—a demand which will no doubt be lessened, but will by no means be destroyed, by what is being done in France by the *Compagnie d'Exploitation*—and I am one of those who have been called upon to endeavour to supply that demand. M. Pechiney is now preparing to make at Salindres a trial on an industrial scale of a process which, I think, will supply it; and by the end of this year he will probably have obtained decisive results.

As regards the English chlorine industry, however, I do not think that its prospects are by any means so gloomy as, from what I have said so far, might at first blush appear. But I think that its salvation will come from an unexpected quarter. I think that our English manufacturers of Leblanc soda will have to cease to devote their hydrochloric acid—when they do not throw it away—exclusively to chlorine making. They would, of course, be only too glad to do so if a means could be furnished them of turning it to account otherwise, but the difficulty hitherto has been as to how to turn it to account otherwise. I believe that that difficulty is about to disappear. I am not free to enter into that matter now, and, indeed, it is not yet ripe for discussion; but I have very great confidence that new applications of hydrochloric acid, admitting of being applied very extensively, at comparatively small expense, are among the things of the immediate future.

(To be continued.)

Studies on Argentous Oxide.—Dr. W. Pillitz.—The author shows that the preparations known under this name do not represent a definite compound, and do not contain silver in an oxidised state.—*Zeitschrift*.

NOTICES OF BOOKS.

Report on Different Systems of Sewage Disposal. By C. F. HANCOCK. Presented at the meeting of the Hendon Local Board held the 25th November, 1882.

THE author of this report has made enquiries concerning the disposal of sewage by precipitation, by irrigation, and by the pail system. We find in the first place mention of the process of Mr. Fritz Hillé, which is said to be in successful operation at Tottenham, Edmonton, and Aldershot. At this last-mentioned place it has, as we understand, been abandoned. As regards the quality of the effluent produced no definite evidence is given. We have visited Tottenham, and found that the effluent water was being discharged into the Lea—not through an open channel, but through an open pipe which vents at some depth below the surface. It hence is immediately mixed with the river water, and it is impossible to judge of its colour, odour, &c., much less to draw a sample for analysis.

The account of the lime process calls for little comment. When used it is generally either preceded or supplemented by filtration. When the sewage is poor in organic matter, or where—as at Leeds, and we may add Bradford—it has to be discharged into a very dirty river, it may pass. It must be noted that the Mayor of Birmingham merely states that “to a certain extent it has been effective,” but that it has not been a “great success.” Like all the processes in which lime plays a substantive part, *i.e.*, where it does more than neutralise acids or acid salts, it fails to remove colouring matters from the water.

Goodall's process, we learn, has been abandoned at Newcastle-under-Lyme.

Irrigation is, of course, recommended by Dr. A. Carpenter, of Croydon, and Col. Jones, of Wrexham. Considering that even in France irrigation is found to chill the soil and retard the crops, we cannot, in our wetter and chillier climate, look upon its general adoption with favour.

The English Dyer. By DAVID SMITH. Manchester: Palmer and Howe. London: Simpkin, Marshall, and Co.

THIS work is not, as many persons seem to believe, a reprint of the “Practical Dyer's Guide,” by the same author. It contains instructions for dyeing 150 shades on cotton yarns, 50 on cotton wool, 150 on worsted yarns, 100 on wool, and 50 on silk in the skein, each receipt being accompanied by a dyed pattern showing the result. There are also instructions for piece-goods, such as damasks, camlets, and lastings; for woollen shawls; for padding; for printing silk warps, skeins, and handkerchiefs; for dyeing woollen cloths, merinos, orleans, and cobourgs. This latter portion of the work is not illustrated with dyed patterns, except in the case of some receipts for fine aniline colours on cloth. On the last page are specimens of cotton yarns dyed with alizarin colours, the shades being named respectively Turkey-red, scarlet, purple, and pink. These shades, which are very fine, are not accompanied with receipts. The author remarks that “as the dyeing of these permanent colours is a speciality, special arrangements will have to be made for instructions to dye them, for I feel convinced that if I were to give a full and clear information on the making of the mordants and the manner of using them, no man without a practical knowledge of this hidden treasure could manipulate these colours.” This is so far correct that we have seen dyers well conversant in producing the old wood, &c., colours, the cochineal, and the aniline shade, prove but very imperfectly successful with the alizarin, or, as they were formerly called, the madder colours.

An important feature in the book consists of receipts for thirty “one dip dyes” on cotton yarns. The necessity now felt for economising time and labour has caused a

great demand for methods of dyeing which can be completed in one bath.

Almost all the appended patterns are good of their respective kinds, so that the accompanying receipts may be used with confidence. There is also much useful information on dye-wares, mordants, &c., and a glossary of terms. We may safely say that the author merits the good-will of the British dyeing trade for his diligence in furnishing them with sound practical instruction.

The Minerals of New South Wales. By ARCHIBALD LIVERSIDGE, F.R.S., A.R.S.M., Professor of Chemistry and Mineralogy in the University of Sydney, &c. Second Edition.

THIS contribution to the mineral wealth of New South Wales was originally read as a paper before the Royal Society of the Colony in 1874, and appeared in the *Transactions* of the Society for that year. Since that time every opportunity has been taken advantage of by the author to correct and extend it, particular attention being paid to the chemical composition of the minerals. The specimens described are mainly those which the author has collected or have come under his own personal observation.

The pamphlet is divided into two parts—metallic and non-metallic minerals. In the former an interesting account is given of native gold found in the Colony in the form of nuggets and dust, its associations, and numberless assays of the metal from different localities, to which are added quotations from various sources regarding the long-disputed question as to the discovery of gold in the colony. This latter matter we think might have been more appropriately given as an appendix. The principal minerals containing copper and iron are pretty fully treated of, chemically and geographically, and statistics are given showing the quantity of copper produced in the Colony for the last twenty-three years.

It is interesting to note that native lead is again reported to have been found—this time by the miners in the gold-fields, in association with serpentine. One specimen examined by the author did not seem to have been reduced artificially, although he states that the majority of the specimens which have passed through his hands were derived from bullets.

The very rare mineral Greenockite is said to have been found associated with zinc blende and quartz. Antimony is represented by stibnite, cervantite, and jamesonite; no authentic record, however, has yet been made of the occurrence of the native metal.

The interesting fact is pointed out by the author that nearly all the minerals that are usually found associated with cassiterite in Cornwall, Germany, and France are met with this mineral in New South Wales, and mentions the finding of tin-stone pseudomorphous after felspar crystals similar to those from St. Agnes Mine, Cornwall. As an example of the occurrence of the cerium metals we have an analysis of a mineral containing them, which would seem to correspond with the composition of monazite.

In Part II. many of the commoner non-metallic minerals found in the colony are described, including the carbonaceous species and gems. A considerable portion of this section is taken up with valuable analyses of the coals, their calorific intensities, yield of coke, and general physical properties. The quantity of sulphur in these fuels, the author says, “is by no means excessive, and they will in this respect compare not unfavourably with those of other countries.”

With the descriptions of the species are given the percentages of the constituents, which is necessary; but we think it objectionable to attach formulæ as well, especially as no table of chemical equivalents is given, or what new and mixed system the author has adopted. For instance, we have AgCl and AgS for kerargyrite and argentite, also Sb₂S₃ for stibnite, SbO₄ for cervantite, and H₂O for water.

As a descriptive mineralogical account of a vast area

this work is but a small instalment of what might be expected from a colony with such mineral wealth at its disposal: it is, however, a step taken in the right direction, and will doubtless do much good service in showing up the mineral resources of New South Wales.

Report of the Commissioner of the Imperial Mint for the Year ending the 30th of the 6th month of the 15th Year of Meiji (30th June, 1882). Hiogo.

The vast strides which the Japanese are making towards "Civilisation" is amply shown by such reports as the one now before us. As a criterion of their enterprising spirit we think hardly anything better could be obtained than the statistics of their coinage as is here offered for examination. During the past year the amount of gold bullion imported into the Imperial Mint exceeded thirty-eight thousand troy ounces, the silver bullion almost three-and-a-half million ounces, and of copper about one-and-a-million pounds. The grand total value of coins struck during the year equalled five-and-a-quarter million yen. The gold and silver passed through the refinery exceeded fifty-five thousand ounces of the former metal and six-hundred and-seventy thousand ounces of the latter.

Under the able supervision of Mr. W. Gowland, A.R.S.M., important improvements have been introduced into the metallurgical processes connected with the coinage and the working up of old bronze guns for copper money. In the refining process an experimental trial has been made of Gutschow's method of parting, in which ferrous sulphate is used for precipitating the silver, instead of copper, with such satisfactory results that in future the process is to be adopted whenever the cupric sulphate produced as a by-product in the latter process cannot be disposed of to advantage.

The standard of the coinage, as checked by the English and United States Mint Assayers, is maintained with wonderful exactness.

Although the Japanese are credited with being an ingenious and crafty race, we note with interest that only six counterfeit coins are reported during the year, from various localities.

CORRESPONDENCE.

ESTIMATION OF CHLORINE IN BLEACHING-POWDER.

To the Editor of the Chemical News.

SIR,—The method of estimating the available chlorine in bleaching-powder, given by Mr. J. W. Chalmers Harvey, would be far too tedious for ordinary use. It is more easily estimated by Penot's method, given by Fresenius, viz., by a standard solution of sodium arsenite, the end of the reaction being denoted by potassium iodide and starch paper. Having a number of bleaching-powder samples to do in a day, I should find it a very lengthy task by Mr. Harvey's method, using three solutions, one of which is not reliable on account of its quick oxidation.—I am, &c.,

G. H.

Manchester.

Determination of Tannin in Tanning Materials, Liquids, and Waste-Products.—A. Gawa'ovski.—The methods of Hammer, Müller, Fehling, Handtke, Löwenthal, Wildenstein, Risler-Beunat, &c., are all defective. The volumetric methods are all the more uncertain the larger the proportion of precipitable matter other than tannin. The author prefers Hager's method,—precipitation as copper tannate. He collects, dries, weighs; then ignites, and deducts the weight of the residual copper oxide from the weight of the copper tannate.—*Zeitschrift*,

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 4, 1882.

Tables for the Rapid Determination of the Alcohol in Spirituous Liquors by the Distillation Method.—Dr. G. Dahm.—These tables are founded upon those of Hehner.

Causes of the Chlorine Present in Oxygen Gas prepared from Potassium Chlorate.—A. Wagner.—Commercial potassium chlorate yields under all circumstances oxygen gas containing chlorine. Chemically pure chlorate yields oxygen free from chlorine if the action of carbonic acid or of organic matter is excluded. Carbonic acid, with the aid of heat, decomposes pure potassium chlorate in such a manner that chlorine is liberated. Organic substances act in a similar manner, and the residue has a strongly alkaline reaction. The presence of calcium chlorate also occasions the liberation of chlorine. The manganese ore used for the preparation of oxygen gas along with potassium chlorate, not unfrequently contains an appreciable quantity of organic matter.

Determination of Titanic Acid in Presence of Iron.—E. Wigand.—The author criticises the method of Pisani (see *Comptes Rendus*, lix, p. 289, 1864, and *Zeit. Anal. Chemie*, iv., p. 419, 1865), and shows that it is untrustworthy.

The Qualitative Detection and the Quantitative Determination of Arsenic, Sulphur, Phosphorus, and Foreign Metals occurring in Small Quantities in the Copper of Commerce.—Dr. J. Loewe.—Reserved for insertion at length.

The Volumetric Determination of Phosphoric Acid.—Drs. Kratschmer and Sztankovansky.—The authors have examined Perrot's volumetric process for the determination of calcium and magnesium phosphates by means of a solution of silver nitrate. They confirm and correct the statements of Perrot. The yellow precipitate formed by the alkaline salts of ortho-phosphoric acid with silver nitrate is tribasic silver ortho-phosphate, insoluble in water, but soluble in nitric acid and ammonia. A complete separation of phosphoric acid from alkalis and alkaline earths by means of silver is practicable. The authors pour into a measuring flask the accurately-measured quantities of the solution of the phosphate and of silver nitrate (1 c.c. = 0.001 grm. phosphoric acid), the latter being of course in excess, apply heat, add, if necessary, dilute ammonia from a burette till perfect neutrality is reached, boil up, let settle, and grow cold. If the clear supernatant liquid is found to be neutral, and if a drop of dilute ammonia does not occasion a trace of turbidity, the flask is filled up to the mark with water, closed with a caoutchouc stopper, and the contents well mixed by inversion, and filtered. Aliquot parts of the filtrate are now taken, and the excess of silver determined in them by back-titration according to known methods. The authors consider the method accurate, easy, and expeditious.

Detection of Benzoic and Boric Acids in Milk.—Dr. E. Meissl.—For benzoic acid 250 to 500 c.c. of milk are rendered alkaline by means of a few drops of lime or baryta water, evaporated down to one-fourth, stirred up to a paste with gypsum, and dried on the water-bath. Sand or pumice may be used instead of gypsum. The dry mass is finely powdered, moistened with dilute sulphuric acid, and three or four times shaken up with double its volume of cold alcohol at 50 per cent. The alcoholic extracts, which, in addition to benzoic acid, contain lactose and inorganic salts, are united, neutralised with

baryta water, and concentrated to a small bulk. This residue is again acidulated with dilute sulphuric acid, and finally shaken up with small quantities of ether. The ethereal extract on evaporation leaves benzoic acid in a state of almost absolute purity. For the quantitative determination this residue is dried in the desiccator, weighed, the benzoic acid is expelled by sublimation, and the residue is weighed again, the loss being benzoic acid. Sublimation is best effected in the water-bath, the capsule being covered with a watch-glass. As soon as the benzoic acid begins to sublime, the space beneath this glass appears full of minute spangles of benzoic acid, and is very characteristic. As soon as the larger portion of the benzoic acid is deposited in the covering glass it is removed, and the contents used for qualitative reactions. The lower capsule is heated uncovered till all the benzoic acid has escaped. The test with neutral ferric chloride succeeds best with the benzoic acid dissolved in water and mixed with a drop of sodium acetate. Boric acid is not capable of quantitative determination, except present in such quantities that its weight may be deduced from the increased percentage of the ash. The flame-reaction is untrustworthy, as the ash of pure milk gives a flame bordered with green. The following method is recommended: 100 c.c. milk are rendered alkaline with lime water, evaporated down, and incinerated. The ash is dissolved in a minimum of strong hydrochloric acid, filtered from the carbon, and evaporated to dryness. The residue is moistened with a little dilute hydrochloric acid, the crystalline paste is moistened with tincture of turmeric, and dried on the water-bath. In presence of the smallest trace of boric acid the dried residue is of a distinct vermilion, or cherry red. In this manner 0.001 to 0.002 per cent in the milk can be distinctly recognised. Strong hydrochloric acid gives also a cherry red colour with turmeric, which, however, disappears on the addition of water, and on drying turns brown. The boric colour only appears on drying, and is not removed by water except boiling or in excess.

Method for Determining the Fixed Organic Acids in Wine, and a New and Accurate Method for Determining free Tartaric Acid.—C. Schmitt and C. Hiepe.—The acids in question are the tartaric, the malic, and the succinic. The first-mentioned must be removed before the two others can be determined. The authors pronounce the method of Kayser (*Repertorium Anal. Chemie*, i., p. 20) inapplicable. The principles of their method are:—(1.) Separation of the entire tartaric acid from the concentrated neutralised wine as a calcium salt and calculation of its quantity from the normal hydrochloric acid required for neutralising the caustic lime obtained on igniting the calcium tartrate, with a correction for the tartaric acid remaining in the filtrate. (2.) Precipitation of the mixed calcium salts of malic and succinic acids by the addition of alcohol. (3.) Conversion of these weighed calcium salts into neutral alkaline salts, precipitation of the succinic acid, calculation as a calcium salt, and calculation of the malic acid from the difference in weight of the total calcium salts and the calcium succinate. For precipitating the succinic acid a property is utilised which is not yet known. Neutral alkaline succinates are at once and completely decomposed by barium chloride at a boiling heat. The deposit of barium succinate is dissolved with hydrochloric acid. From this solution the baryta is thrown down with sulphuric acid, and 1 mol. barium sulphate in the precipitate represents 1 mol. succinic acid.

Absorption Apparatus for Elementary Analysis.—Clemens Winkler.—The author figures and describes a new and apparently advantageous apparatus for the absorption of carbonic acid, watery vapour, &c.

Detection of Organic Acids in Phenol.—W. Bachmeyer.—Whilst a single drop of the ordinary inorganic acids in a concentrated state decolourises the aqueous extract of sapan wood, &c., but a further addition brings

out the red colour again, the organic acids, with the exception of phenol, behave differently, since an excess does not reproduce the colour. The author has examined in this respect the acetic, oxalic, malic, tartaric, citric, succinic, uric, benzoic, hippuric, salicylic, and tannic, and found that all produce the permanent discharge of the colouring-matter. An aqueous extract of any of the red woods is therefore well suited for detecting any organic matter present in phenol, and especially for distinguishing phenol from salicylic acid in the absence of other acids.

Detection of Soda in Milk.—W. Bachmeyer.—The milk to be examined must have an alkaline reaction, which will always be the case in recent milk sophisticated with soda. The cream is removed and portions of 15 c.c. are placed in flat capsules. To the first are added 3 c.c., to the second 5 c.c., and to the third 10 c.c. of a moderately strong solution of tannin, and the samples are then allowed to stand eight to twelve hours in a cool place. The author's experiments show that a proportion of soda of 0.3 grm. per litre betrays itself by a deep, dirty greenish blue colour; samples free from soda, after standing from twelve to twenty hours, show at most a dull grey. The test is confirmed by the addition of a few drops of dilute acetic acid, which produce in the greenish samples a transitory green colouration.

Determination of Phosphoric Acid and Magnesia.—Dr. K. Broockmann.—The usual method of determining ammonium magnesium phosphate as magnesium pyrophosphate by ignition involves certain sources of error which cannot be avoided, even with the utmost care. Such are the double salts creeping up the sides of the beaker and of the funnel, so that it is not readily brought into the filter without loss; then there is loss in the form of dust on introduction into the crucible, and thirdly there are variations in the ash of the filter. To avoid these sources of error the author dissolves the washed precipitate direct from the filter, and any particles present in the beaker in nitric acid, places the solution in a weighed crucible, evaporates to dryness, and ignites.

Colorimetric Determination of Small Quantities of Phosphoric Acid.—J. West-Knights.—From the *Analyst*.

Behaviour of Nitric Oxide with Potassium Permanganate.—A. Cavazzi.—Nitric oxide is converted into nitric acid by solution of permanganate. The author recommends a hot concentrated solution of permanganate as an excellent absorbent for nitric oxide in gas analysis.

MEETINGS FOR THE WEEK.

- MONDAY, Feb. 19.—London Institution, 5.
— Medical, 8.30.
— Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field.
- TUESDAY, 20th.—Royal Institution, 3. "The Supreme Discoveries in Astronomy (The Scale on which the Universe is Built)," by Professor R. S. Ball.
— Institution of Civil Engineers, 8.
— Pathological, 8.30.
- WEDNESDAY, 21st.—Society of Arts, 8. "Recent Improvements in Agricultural Machinery," by D. Pidgeon.
— Meteorological, 7.
— Geological, 8.
- THURSDAY, 22nd.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.
— London Institution, 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Society of Arts, 8. "Some Causes of Fires and Methods for their Prevention," by Walter G. McMillan, F.C.S.
- FRIDAY, 23rd.—Royal Institution, 8. "Sir Francis Drake," by Mr. W. H. Pollock, at 9.
— Quekett Club, 8.
- SATURDAY, 24th.—Royal Institution, 3. "Singing, Speaking, Stammering," by Dr. W. H. Stone.
— Physical, 3. "Optical Combinations of Crystalline Films," by Lewis Wright. "Experimental Demonstration of the Vortice Theory of the Formation of a Solar System," by Philip Braham.

THE CHEMICAL NEWS.

VOL. XLVII. No. 1213.

ON THE EXAMINATION OF AMERICAN CHEESES.

By A. B. GRIFFITHS, F.C.S.,
Member of the Liverpool Association of Science and Arts,
Medallist in Chemistry and Botany, &c.

THE author has recently submitted to careful analysis four samples of American cheese purchased in London, and handed to him for analysis. The results are as follows:—

	I.	II.	III.	IV.
Water.. ..	23.49	28.20	26.55	31.81
Caseine ..	36.21	37.01	35.58	36.10
Fat	34.92	30.18	33.85	28.68
Ash	5.24	4.51	3.90	3.40
	99.86	99.90	99.88	99.99

The author also made a separate analysis of the rind in each case, and in samples Nos. I. and IV. a small amount of arsenic was found. This was probably applied to the external surfaces of the cheeses to prevent the attacks of insects, &c.,—a practice which is dangerous to the consumer, and ought to be prohibited by law. I also examined microscopically each of the samples of cheese for vegetable fibres, &c., and starch granules, but found no traces.

London, January 31st, 1883.

SUPERSATURATION.

By SPENCER UMFREVILLE PICKERING,
B.A. (Oxon.)

SUPERSATURATION is not, I believe, generally supposed to take place in a solution when any of the solid substance is present: I had occasion, however, to notice an instance in which it took place under these circumstances to a marked extent.

A boiling saturated solution of copper sulphate had been left to filter undisturbed into an open beaker. When almost cold a considerable crop of crystals had formed on the bottom and sides of the beaker and on a glass rod in it; but on moving this rod a sudden deposition of very small crystals of the sulphate took place, amounting to about twice the quantity of those which had separated slowly, and which could not have weighed less than 100 grammes.

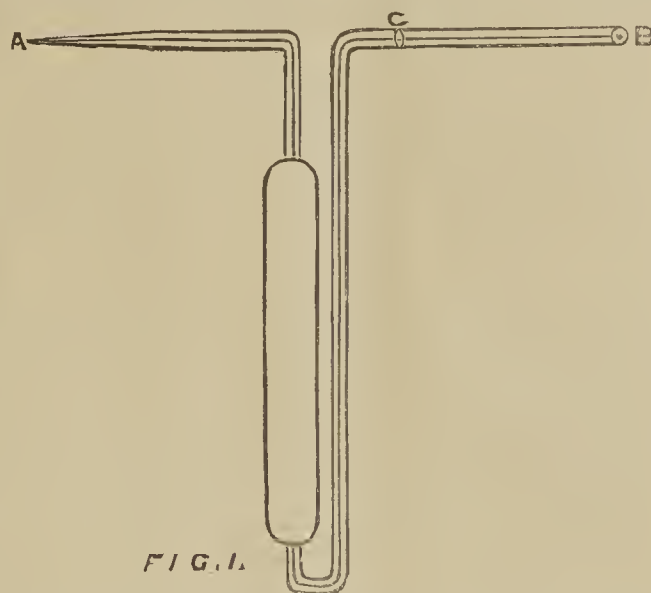
NEW AND MODIFIED SPECIFIC GRAVITY APPARATUS.

By W. W. NICOL.

IN the Chemical Society's *Journal* for 1873, p. 577, occurs a description of the now well-known Sprengel tubes for the determination of the specific gravity of liquids. The form there described has, however, certain disadvantages: it is by no means easy for an inexperienced glass-blower to make such a tube, and when made it is difficult to fill without including air bubbles, or entailing some loss of liquid. After I had used the above form for some time, I modified it as follows, and have used this modified form in many hundred experiments without observing that it

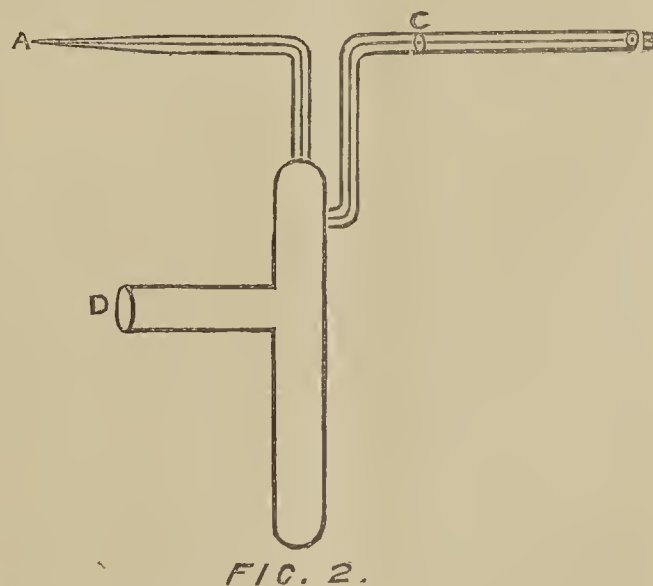
is in any way inferior in accuracy to the original form described by Sprengel.

The accompanying figure (1) gives the form of the tube. It is made from a test-tube 15 m.m. in diameter, the length of the wide part is 115 m.m., and the distance from the shoulder to the bend is 40 m.m. to allow of the total immersion of the body of the tube in the water of the constant temperature bath. The capillary tubes have



an external diameter of about 2.5 m.m., and a bore of 0.5 to 0.7 m.m. The total length from A to B is 180 m.m., and the mark is at C. Such a tube weighs 15 to 16 grms., and holds 13 to 15 c.c., and is capable of giving results with a maximum error of ± 0.00002 .

The above form of tube can of course only be used to determine the specific gravity of liquids, but the following modification adapts it for the determination of that of solids soluble in water (Figure 2):—The only differences



from the foregoing are that the wide capillary starts from the upper part of the body of the tube, and that half way down a wide open tube is joined in at right angles. The use of this apparatus is as follows: The salt (in fine powder) whose specific gravity is to be determined, is shaken in by D. The outer edge of D is then softened in the blowpipe flame, closed, and rounded by gently blowing in at B. The whole is then weighed, partially filled with paraffin oil, the air exhausted by B until on shaking up the powdered salt no air bubbles make their appearance, then filled up with paraffin, and, after attaining the temperature of the bath, again weighed. Then washed out with water and alcohol, dried, and weighed—first empty, then

full of boiled water, and finally full of paraffin oil. These five weighings give all the data necessary for the calculation. To use the tube again all that is necessary is to soften the end of D in the flame and to blow it open. The time required for a determination with this apparatus is rather more than that when using the bottle, but the accuracy exceeds greatly that obtainable by the ordinary method.

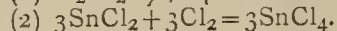
The Mason Science College, Birmingham,
February 3, 1883.

NEW PROCESS FOR THE RAPID VOLUMETRIC ESTIMATION OF CHROMIC ACID IN CHROMATES AND BICHROMATES.

By J. W. CHALMERS HARVEY.

THE *modus operandi* of this method is the same as in the one I proposed for the rapid estimation of peroxide of manganese in commercial bin oxide (CHEMICAL NEWS, vol. xlvii., p. 2).

The principle of it consists in heating the sample to be analysed with excess of stannous chloride and hydrochloric acid, the reactions taking place being:—



The excess of stannous chloride is determined by mixing the solution with an excess of ferric chloride and estimating the equivalent quantity of ferrous chloride which it forms by a standard solution of potassic bichromate. The reaction in this case is—



From these equations it is seen that two molecules (200.4 parts) chromic acid oxidise the same quantity (viz., three molecules) of stannous chloride as three molecules ferric chloride containing 336 parts iron.

Now, if we take two equal measured quantities of a strong solution of stannous chloride, mix one directly with excess of ferric chloride, heat for a short time, and estimate the iron converted into the ferrous condition by the standard bichromate of potash, then add to the other measured quantity the chromate to be analysed, some hydrochloric acid, and heat until complete decomposition is effected, treat this also with an excess of ferric chloride, and lastly estimate the iron converted into ferrous chloride: we get a difference which is due to the oxidising function of the chlorine evolved by the action of the hydrochloric on the chromic acid. Now as we know that 336 parts iron as ferric chloride are equal to 200.4 parts chromic acid in oxidising power, it is easy to find the percentage of this latter. Suppose 1 grm. substance has been taken, and that the difference when multiplied up to the percentage = 67 parts iron, then—

$$\begin{array}{ccccc} Fe & CrO_3 & Fe & & \\ 336 & : 200.4 & : & 67 = x = 40 \text{ per cent } CrO_3. \end{array}$$

The requisites for this process are as follows:—

Standard Solution of Potassic Bichromate.—Dissolve 15 grms. of the pure salt in hot water, and when cool make up to 1 litre. 1 c.c. = 0.017 grm. iron = 0.01014 grm. chromic acid.

Solution of Stannous Chloride.—This should contain stannous chloride in the proportion of 330 grms. to 1 litre. It is made by heating the salt with hydrochloric acid until a clear solution is obtained, and then diluting up to 1 litre if the above quantity has been weighed out.

Solution of Ferric Chloride.—Prepared by dissolving pure iron wire, or almost pure peroxide of iron, if obtainable (say pencil hematite), the former in hydrochloric acid, oxidising with potassic chlorate, and evaporating off excess of chlorine, the latter in hydrochloric acid. This solution must be absolutely free from ferrous chloride and chlorine. I used ferric chloride made from hematite

iron ore containing 64 per cent metallic iron. The ore when dissolved was found to contain a trace of ferrous chloride, which was oxidised by heating with a little potassic chlorate. 50 grms. of this ore were dissolved = 32 grms. iron, and made up to 1 litre. The iron solution need not of course be of this particular strength; it may vary, but should not be too dilute.

Conduct of Process.—Suppose the substance in which the chromic acid is to be estimated be potassic bichromate. Weigh out 1 grm., place in a beaker, add 10 c.c. of the stannous chloride, then some hydrochloric acid, cover the beaker with a watch glass, and heat until complete solution is effected; now mix with excess of ferric chloride (an excess may be ascertained by testing a drop of the solution with potassic sulphocyanide), heat again for a minute or two to promote the action of the stannous chloride on the ferric chloride, and lastly titrate with the standard bichromate until a drop of the solution when tested just fails to give a bluish green colouration with potassic ferricyanide. Note the number of c.c. used to effect this result. Now mix 10 c.c. of the stannous chloride directly with an excess of ferric chloride, heat for a short time, and titrate with the bichromate as indicated above until all the iron is oxidised to ferric chloride. Note the number of c.c. used. The difference between the number of c.c. used in the two experiments when multiplied on 0.017 gives a quantity of iron which would have been deoxidised if the stannous chloride had not been previously heated with the chromate; this, therefore, is equivalent to the chromic acid contained in the chromate, and as the quantitative relation between these two substances is known, the amount of chromic acid is easily calculated.

But it is much easier to multiply the difference between the number of c.c. by 0.01014, which is the $CrO_3 =$ to 0.017 grm. iron; this being the value of each c.c., the number obtained when multiplied by 100 gives the percentage.

Experiments to Test the Accuracy of the Process.—Four experiments conducted in this manner with potassic bichromate gave:—

	Theory.	Above Process.
Chromic acid ..	67.88	67.72 per cent
" ..	—	67.73 "
" ..	—	67.93 "
" ..	—	67.93 "
Mean		67.83 "

Plumbic chromate was prepared by dissolving plumbic acetate in water, heating, and precipitating with potassic bichromate. The precipitate was collected on a filter, washed thoroughly with hot distilled water, and dried for a considerable time at 212° F.

Three experiments conducted as described gave:—

	Theory.	Above Process.
Chromic acid ..	31.08	31.18 per cent
" ..	—	31.28 "
" ..	—	31.28 "
Mean		31.24 "

In estimating the chromic acid by this method in the above salt some $PbCl_2$ precipitates, but this does not interfere with the estimation.

Baric Chromate.—This was prepared by precipitating barium chloride with potassic bichromate, collecting the precipitate on a filter, washing thoroughly with hot distilled water, and drying for a long period at 212° F.

Three experiments gave:—

	Theory.	Above Process.
Chromic acid ..	39.65	39.85 per cent
" ..	—	39.64 "
" ..	—	39.54 "
Mean		39.67 "

With the plumbic and baric chromates, 5 c.c. of the stannous chloride are sufficient for 1 grm. substance used.

The strength of the stannous chloride should always be determined before each series of experiments, its liability to change being well known. Although the above process may seem rather complicated, in reality it is not so, and on the score of expedition it certainly lacks nothing, an estimation being performed in ten minutes or so. In regard to accuracy it will be observed that the results are pretty nearly in accordance with theory.

My best thanks are due to my assistant, Mr. Hugh Davidson, who assisted me with the necessary experiments.

Chemical Laboratory,
Maryport Iron Works, Maryport,
February 3, 1883.

THE ACTION OF POTASH UPON ALBUMEN.

By G. STILLINGFLEET JOHNSON.

I HAVE recently been investigating very carefully the changes undergone by the *sulphur* of albumen when that substance is boiled with solutions of potash of various strengths, and, as the results are interesting and, to some extent, unexpected, I am anxious to lay them before scientific chemists, that they may be put to the test of experiment.

The general consensus of opinion of chemists upon this subject is thus epitomised: "Dilute solutions of potash and soda mix with albumen in all proportions, and on boiling the liquid an alkaline sulphide is formed." (*Vide* "Watts's Dictionary of Chemistry," vol. i., p. 67.) Now this statement I believe to be erroneous, and my belief is based upon the following experimental evidence:—

If white of egg or pure albumen be boiled with dilute solution of potash in presence of lead, *e.g.*, in a solution of lead hydrate in excess of potash, an abundant production of *lead sulphide* is observed. But if white of egg or pure albumen be boiled with dilute potash alone (sp. gr. 1.08), the sulphur of the albumen is not converted into sulphide of potassium, but gradually enters into combination with oxygen and potassium, to form a salt of potash with an oxidised sulphur acid; the proof of this being that if the liquid be cooled at intervals of ten minutes, and solution of lead be added to the cold alkaline solution, no lead sulphide is produced, and after the boiling has been prolonged for a certain time, no sulphide is formed even on boiling in presence of lead.

Now, in performing these experiments, it is necessary to bear in mind that white of egg is not pure albumen. When fresh white of egg is boiled with dilute potash for a short time, the liquid cooled, and some solution of lead acetate added, a deep red colour is produced, which might easily be mistaken for an indication of sulphide. But if a solution of white of egg be filtered through charcoal, and subsequently boiled with dilute potash, and then tested with lead, no red colour is produced. If the white of egg solution decolourised by charcoal be boiled with solution of lead hydrate in dilute potash, lead sulphide is at once formed, thus proving that the sulphur of the albumen is not removed by the charcoal. Again, if pure albumen, prepared by the method of Wurtz, be tested by boiling with weak potash alone, and with the same potash in presence of lead, no indication of the formation of sulphide is obtained, either as colouration or precipitate, in the alkaline albuminous liquid containing no lead, whilst that which was boiled in presence of lead is full of precipitated lead sulphide.

Those who have repeated my experiment of subjecting albumen to the prolonged action of boiling dilute solutions of potash have concurred with me as to the fact that, after sufficiently prolonged boiling, no indication of sulphide can be obtained in the boiled liquid. A theory has been proposed to account for this fact, retaining the hypothesis that an alkaline sulphide is produced, *viz.*, that sulphide of potassium is first formed, and undergoes gradual

oxidation by the oxygen of the air during the boiling. My objection to this theory is based upon the results of two experiments: First—If the ebullition of the albumen and dilute potash be conducted in an atmosphere of carefully-purified hydrogen gas, the result is the same as when it is conducted in presence of air, *i.e.*, after a sufficiently-prolonged ebullition, no sulphide can be detected in the boiled liquid, even on boiling in presence of lead. Secondly—If the alkaline albuminous solution, which has been boiled in presence of air till no indication of sulphide can be observed, be mixed with some concentrated solution of potash (sp. gr. 1.3) and again boiled, an abundant production of sulphide occurs. Now, neither sulphate of potash nor hyposulphite of potassium undergoes reduction to sulphide when boiled with concentrated potash and solution of albumen which has been deprived of its sulphur by ebullition with strong potash and lead and filtration from the lead sulphide. But the whole of the observed phenomena are accounted for upon the hypothesis that the sulphur of the albumen is converted by ebullition with dilute potash into *tetrathionate*.

Tetrathionate of potash is stable, or, at least, yields no sulphide, when boiled with dilute solutions of potash, but it produces sulphide of potassium in abundance on boiling with concentrated potash. Of course it follows from this that alkaline sulphide will be produced when albumen is boiled with concentrated potash from the first, as has actually been observed. Nevertheless, I think I am justified in asserting that the sulphur of albumen is converted, *not* into sulphide, but into tetrathionate, when the albumen is boiled with potash, and that the formation of sulphide of potassium when strong potash is employed is simply due to the instability of tetrathionate of potash in boiling solutions of that reagent.

King's College, February 15, 1883.

ON THE PRESENT CONDITION OF THE SODA INDUSTRY.*

By WALTER WELDON, F.R.S.,
Chevalier de la Légion d'Honneur.

(Concluded from p. 81).

As regards soda, the position of the English Leblanc soda-makers is this. They are now working, when not actually at a loss, at least without profit. Until comparatively recently, they supplied the whole of the English demand for soda, the whole of the American demand for soda, and a large part of the Continental demand for soda. Both their home market, however, and their American market have been recently invaded by English-made ammonia soda, and now the manufacture of ammonia soda has begun in the United States themselves, and will have reached there, before the expiration of this year, a scale of 20,000 tons per annum, while a little later on that Belgian soda and copper work of which I spoke will not only have put an end to all export of English soda to Belgium, but will, doubtless, also be sending Leblanc soda to America; as will also, no doubt, the great work which is being built at Marseilles, and, eventually, those other works which are about to be built at others of the French sea-ports. The exportation of English soda to Austria, which has already dwindled to little more than 8000 tons per annum, is expected to cease entirely before the end of the present year, by reason of the increased quantity of ammonia soda which will soon be made in Austria. An increased production of ammonia soda is similarly expected to put an end, almost immediately, to the importation of English soda into Germany, which importation in 1881 was already only two-thirds of what it was in 1879. Russia, moreover, will soon be making for herself at least a portion of the soda she consumes; and France, which country has hitherto been entirely dependent upon

England for her supplies of caustic soda, though she has long ceased to take from us any other form of soda, will soon be making herself all the caustic soda she requires; for, apart from what may be done by the new company of which I have spoken, M. Solvay is just beginning to make caustic soda at Dombasle, and contemplates making it there on a very extensive scale.

In face of all this, how are the English Leblanc soda-makers to continue to live? For one thing, it is quite certain that they must have cheaper pyrites. The present price of 6d. per unit is an artificial price, entirely due to a trade combination; and that price will certainly have to be reduced by at least 50 per cent. That it can be reduced to 3d. per unit, and yet leave a very fair profit to the pyrites sellers, I believe there can be no doubt. At the present price of copper, and at 3d. per unit for sulphur, pyrites showing 2½ per cent of copper by Swansea assay would sell for thirty-nine shillings per ton; and that Spanish pyrites can be delivered to English ports at that price at a fair profit is, I believe, unquestionable. If, therefore, the existing companies refuse to supply pyrites at that price they will simply call into existence other companies which will supply it at that price. That the Leblanc soda-makers will thus get their sulphur at a price not exceeding 3d. per unit, after the end of next year, when the present combination between the pyrites companies will expire, may be regarded as quite certain.

Pyrites at 3d. per unit, however, would by no means bring down the cost of Leblanc soda to that of ammonia soda. Without using any figures which have been given to me privately, there is no difficulty in arriving, very approximately, at the difference between the cost of ammonia soda and that of Leblanc soda, from what is matter of public knowledge with respect to the dividends paid by joint-stock companies which make ammonia soda and publish balance-sheets. We learn in this way that, when Leblanc soda is yielding no profit at all, ammonia soda is yielding fully £1 per ton. As to make a ton of actual sodium carbonate by the Leblanc process does not require more than about 13½ cwt. of pyrites, reduction of the price of pyrites to 3d. per unit would thus reduce the cost of Leblanc soda only by about 7s. 9d. per ton of actual sodium carbonate.

Seven shillings and ninepence, however, is something; and, as regards the balance of the pound, there are two resources, which together will, I think, be sufficient to turn the tables upon the ammonia process, and make the good old Leblanc process the cheaper of the two.

One of these two resources consists, of course, in sulphur recovery. If sulphur recovery were the only resource,—which, however, happily it is not—I think it not impossible that the required twelve shillings and threepence per ton of sodium carbonate could be gained by it alone. To this end, except in localities in which there is a demand for sulphuric acid free from arsenic, the sulphur must be recovered, not as sulphuric acid for use again, but as free sulphur, for sale as such. At the general meeting of our Society at Manchester, last July, I explained that, while the Schaffner and Helbig process would yield as sulphuric acid practically the whole of the sulphur of the calcium sulphide contained in the waste treated by it, it would probably yield as free sulphur only four-fifths of the total sulphur contained in the waste as calcium sulphide. Since then reason has arisen for a very confident hope that the whole of the sulphur of the calcium sulphide contained in the waste may be obtained in the free state; in which case the yield will be almost exactly 6 cwt. of free sulphur per ton of actual sodium carbonate manufactured. If, therefore, one were dependent for that twelve shillings and sixpence on sulphur recovery alone the problem would be narrowed to this:—Can free sulphur be obtained from alkali-waste at such a cost, and is there a sufficient demand for free sulphur at such a price, that it shall be possible to sell recovered sulphur, in sufficient quantity, at two shillings and a halfpenny per cwt., or say forty-one shillings per ton, more than the cost of producing it?

As regards the demand for free sulphur, the latest returns published by the Italian Government show that the average annual production of sulphur in Sicily and Italy, during the five years 1875 to 1879 inclusive, was 282,000 tons, of which 216,000 tons were exported. The total quantity of sulphur that could be produced from English alkali-waste does not exceed two-thirds of this latter quantity. The world thus consumes much more sulphur than the English alkali makers could produce, and although to sell all that they could produce they must drive much of the Sicilian sulphur out of the market, in the present "struggle for existence" somebody must go down, and English Leblanc soda-makers may be pardoned for preferring that it should be producers of Sicilian sulphur who have to do so rather than themselves.

The actual cost of Sicilian sulphur, delivered at Marseilles,—transported in the cheapest way, in bulk, at the purchasers' risk—is about £5 per ton. To become masters of the sulphur market, and at the same time to gain by recovered sulphur the required 2s. per cwt., English soda-makers must thus be able to recover sulphur at a cost not exceeding, say, about £2 per ton. They will hardly be able to do that at first, but I think that eventually they will be able to do it. If so, and if chlorine products should again command, as I think they will again command, a reasonable price,—for a price which scarcely pays their cost is, of course, not a reasonable price—the Leblanc process will at least be able to hold its own, even without that other resource to which I have referred, and which I will now proceed to indicate.

There has come to me from Newcastle a very bold but, I venture to think, quite practical suggestion, the result of which can hardly fail to be of enormous importance, not only to the soda industry, but to almost all industries whatever. That suggestion is that the soda-maker should entirely cease to use raw coal as fuel, but should convert all his coal into coke, collecting for sale the oil and ammonia evolved during its conversion into coke, and himself using for heating purposes the gases evolved during the coking operation and the coke itself. It is believed that, in the Newcastle district at any rate, by this mode of proceeding the soda-maker would obtain his fuel virtually for nothing. In that district there is produced per annum some two millions of tons of very small coal or "duff," which is almost a waste-product, and which, singularly enough, yields more oil than the more costly kinds of Newcastle coal, while at the same time yielding a very fair coke, sufficiently good, at any rate, for use in the furnaces of chemical works, especially when its combustion is assisted by that of the gases from the ovens in which the coke is produced; and the value of the oil and ammonia obtained when this "duff" is coked in ovens to which the Jameson system is applied is greater than the cost of the "duff" plus the cost of coking it. And it is probable that improved condensing arrangements will render the yield, if not of oil, at any rate of ammonia, so much greater than the yield hitherto actually realised as to enable the same result to be obtained in the case of ordinary steam coal, not only in the Newcastle district, but in the Lancashire district also. If so, the cost of producing Leblanc soda in both districts will be diminished by almost the total amount of the present cost of Leblanc soda for fuel. I say "almost," because, so far as one can see, the use of raw coal for "mixing" in the black-ash process must still be continued.

And it seems to me that this idea cannot but be as applicable to almost all other industries as to the soda industry; while the result to the material well-being of mankind of its general application it is utterly beyond the power of any imagination adequately to conceive. This idea means, among other things, cheaper fuel for all purposes, an enormously increased supply of agricultural produce, and the entire suppression of smoke even in the busiest centres of industry. It means that manufacturing towns, by and bye, shall no longer deserve such names as that which Mr. Matthew Arnold recently applied to St.

Helens, and may even become tolerable in the sight of Mr. Ruskin.

And for my own part I venture to think that the same idea might be applied even to the fuel required for domestic purposes, rendering London absolutely free from smoke, and pea-soup fogs things only of tradition. I think that the time will come when our gas-works will be replaced, at least to a large extent, by establishments in which coal will be treated for the production of coke, illuminating oils, ammonia, and heating gases: the coke to be burnt in our domestic fire-places, the oils to be used for lighting the interiors of our houses, the ammonia to be employed in agriculture, to cheapen and render more abundant our supplies of food, and the gases to be burnt for raising steam for driving dynamos for lighting our streets by the electric arc.

Coming back to soda: if the suggestion in question will enable makers of Leblanc soda in certain districts to obtain their fuel for nothing, it will, of course, enable makers of ammonia soda, in similar districts, to do the same. How, then, will it help the Leblanc soda-makers? While the quantity of fuel consumed in the ammonia process is only 150 per cent on the soda produced, the quantity consumed in the Leblanc process is about 350 per cent on the soda produced. This lower consumption of coal in the ammonia process than in the Leblanc process has hitherto been one of the chief advantages of the ammonia process; but fuel for nothing will so far convert this advantage into a disadvantage, that it will reduce the cost of ammonia soda per ton only by the cost of one-and-a-half tons of fuel, while it will reduce the cost of Leblanc soda, per ton, by the cost of fully twice that quantity of fuel. No doubt this result will be accompanied by some diminution in that heavy item in the cost of ammonia soda which is due to loss of ammonia; but still I think that the balance of advantage will be on the side of the Leblanc process. It can only fail to be so by reason of ammonia falling to one-half of its present price. The price of ammonia unquestionably will fall; but I think that increased use of ammonia in agriculture will prevent its price falling to anything like that extent.

Besides, then, being certain of getting his sulphur, by and bye, at half its present price, the English Leblanc soda-maker has thus before him the proverbial "three courses"; only, he must not choose between them, but must adopt them all. He must turn his hydrochloric acid to more uses than he does at present; he must recover and sell his sulphur; and he must distil most of his coal. He will then, I believe, be able, not only to hold his own against the ammonia process, but even to incline the balance in his favour.

It is said that "sweet are the uses of adversity"; and those uses, if not "sweet" in any ordinary sense, are at least unusually wholesome. One of the results of the conditions under which Leblanc soda-makers have had to work of late years has been to lead them to do their utmost to economise fuel and labour in all possible ways, and of the extent to which this has been done some figures which have been supplied to me by one of our leading English manufacturers afford a striking example. They are figures for the ten years 1872 to 1882. In 1872, in the work to which these figures refer, per 100 tons of total products manufactured, 336 tons of coals were consumed and £256 paid in wages: while in 1882, per 100 tons of total products manufactured, only 216 tons of coals were consumed, and only £144 paid in wages; the coal consumption in 1882 being thus only 64 per cent, and the wages in 1882 only 56 per cent, of what they were, upon the same quantity of total products, in 1872. How much more it may yet be possible to do in the way of economising fuel and in adopting labour-saving machinery I cannot judge; but I venture to think that there are a number of little ways in which economies remain to be effected, and of these I will ask permission to give just one example.

I would venture to suggest that the English Leblanc

soda-maker, who has taught the Continental Leblanc soda-maker so very much, might in return learn just one or two things from the latter. There can be no doubt that on the Continent, as a rule, and especially in Germany, the Leblanc soda-maker performs to a far less extent than the English Leblanc soda-maker usually does, that useless and costly series of operations which consists in buying salt, transforming it into sodium sulphate, converting that sodium sulphate into carbonate, then converting that carbonate back again into sulphate, and finally giving the sulphate away to his customers, and paying out of his own pocket for casks to put it in. Without entering on the question of the relative proportions of sodium sulphide in English and in German vat-liquors respectively, the ordinary English method of evaporating the vat-liquors and treating the resulting "salts" obviously involves losses of soda which the method of procedure now adopted by all the best German makers wholly avoids. In England, not invariably, but for the most part, the soda-liquors are evaporated by products of combustion passing over their surface, and the resulting "black salts," as they are called, are then "calcined" by products of combustion playing upon and through them. Alike during the evaporation of the liquors, and during the subsequent calcination of the "salts," SO_2 from the products of combustion is absorbed, with the ultimate result that an equivalent of what was soda in the liquors becomes in the final product sodium sulphate. How much soda is habitually lost in this way in England I do not know; but the only careful experiment on the subject with which I am acquainted brought out the loss due to this cause as over two per cent. I cannot think that it averages so much as that; but even if it averages only one per cent, it would be worth avoiding, providing that the cost of avoiding it were not greater than the value of the soda saved. The best German makers do now avoid all loss of soda from absorption of SO_2 , and they believe that they gain other important advantages at the same time. They evaporate their soda liquors in pans heated from below; from these pans they fish by automatic mechanical means perfectly white salts; and then, instead of calcining these salts, either in contact with products of combustion or otherwise, they simply dry them in closed iron vessels heated externally, and now usually furnished with mechanical appliances for crushing the soda as it dries, and automatically feeding it into casks. They believe that by these means they effect an appreciable economy, not only of soda, but of fuel and labour too. The mechanical evaporating and fishing pan which they employ—known, from the name of its inventor, as the Thelen pan,—has been adopted in one work in this country, by Messrs. J. C. Gamble and Sons, of St. Helens; but the Thelen apparatus for drying fished salts and delivering the products into casks has not yet been tried in this country at all.

Of course, the product obtained by merely drying fished salts has not the crystalline brilliancy of soda-ash which has been calcined at a high temperature, and is, moreover, probably slightly more bulky than the latter. Bulkiness is objectionable, because it means more casks; but a preference for mere appearance, apart from actual quality, I think consumers could, if it were worth while, be easily educated out of. When the late Karl von Kulmitz founded the chemical works of Saarau, in Silesia, he did so with a view to supplying soda to the soap-makers of Breslau, who at that time were getting all their soda from England. The soda they were supplied with from England was very red, and the first soda made at Saarau was nice and white. When, however, samples of this white soda were sent to Breslau, the soap-makers there would have nothing to do with it. They said that to make good soap they must have red soda-ash; and, for a time, Herr Kulmitz was obliged, in order to make his soda saleable, to mix with it a little oxide of iron. He managed after a while to educate his customers out of the habit of requiring that their soda should be red, just as some Continental makers of ammonia-soda have had to educate many of their customers out

of requiring that their soda should be very weak. A little similar education of some of the clients of some of the English Leblanc soda-makers might perhaps put an end to the irrational custom of the latter of adding salt to their soda after they have made it. They have to pay for that salt, they get nothing for it (the mixture being sold at so much per alkalimetric degree), and it increases the cost of their products both for casks and for carriage. As in Lancashire, where this custom of reducing by salt chiefly prevails, a hundredweight of salt costs only about fivepence, —though extra cost for casks and carriage raise that fivepence to at least a shilling, or to fully one per cent on the present selling price of 48 per cent ash,—the matter may be considered too small to be worthy of mention; but in the alkali trade the present is a day of small things, when even pence per ton must be economised at every possible point, and when a shilling a ton may mean all the difference between an actual loss and a small profit. Moreover, it so happens that it is my lot nowadays to visit Continental alkali works much oftener than English alkali works, and when I have made a round among the former, and have found every foreign manufacturer whom I have visited eagerly intent, not only on economising to the uttermost fuel, labour, and raw materials, but also upon making his soda as rich and as pure as possible, in order that it may compete with ammonia-soda, and when I then, on getting home, write to an English alkali-maker to ask what a ton of soda now costs him, in order that I may compare his figures with figures which have been given me abroad, and on receipt of his figures I find that he charges each ton of soda with "one hundredweight of salt for reducing,"—while I know that in some sense or other it must be all right, since my friend of course knows his business very much better than I do, I nevertheless cannot help feeling that there is something here which is behind the times—I cannot help feeling that that ignorance on the part of the customer which makes dilution with salt all right for the moment is not going to last, and that if I were an alkali-maker I should do my best to become one of the first in the new state of things which is fast coming, by beginning at once to take such steps as I have seen Continental ammonia-soda makers take to persuade my customers to take my soda as rich as I make it, and not to require me to increase its cost by adding to it what is of no advantage to them.

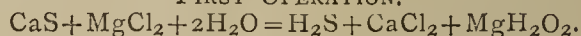
Here the present paper might very well have ended, but I know that it is expected by some of the members present that I should say something on the present state of the sulphur recovery question; and I have, therefore, to ask permission to go on a little longer, in order to do so.

The question of the cost of sulphur recovery is one which I do not propose to go into, for the reason, among others, that Mr. Alexander Chance will before long deal with that question before the Liverpool Section of our Society. The experimental plant for the Schaffner and Helbig process which Messrs. Chance Brothers had in operation at their works at Oldbury this time last year, and which continued in operation till June or July, was then stopped, in order to the erection of a new plant, intended to deal with 300 tons of waste per week. This new plant has been recently got to work, and a little later on Mr. Alexander Chance intends to give at Liverpool a full account of its results, and especially of those of them bearing on the commercial aspect of the process. All I will say of it now, therefore, is, that into this new plant the Messrs. Chance have introduced several important improvements which greatly facilitate the working of the process, and that with the results yielded by it, so far, they are perfectly content.

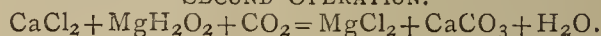
In order to render intelligible some interesting results, relating in some degree to the commercial side of the Schaffner and Helbig process, which were obtained at Oldbury in the autumn, and which I have permission to report, allow me to remind you that the two main operations of that process consist: firstly, in decomposing the calcium sulphide contained in alkali-waste by heating the waste with solution of magnesium chloride,

whereby there is obtained, on the one hand, H_2S , and, on the other, solution of calcium chloride holding magnesium hydrate in suspension; and, secondly, in regenerating magnesium chloride for use again by treating that mixture of magnesium hydrate and solution of calcium of chloride by CO_2 :—

FIRST OPERATION.



SECOND OPERATION.



During the construction of their new plant, Messrs. Chance Brothers made a series of quantitative experiments, upon a scale of half a ton of waste per operation, mainly with a view to determining quantitatively the loss of magnesia involved in the process. These experiments were conducted by Mr. Frederick Chance,—a young member of the firm, who has only to fulfil the promise of his youth to take a very high rank among industrial chemists,—and their results are interesting and to a certain extent important. By making a number of successive operations without adding any fresh magnesia or magnesium chloride, and comparing the quantity of magnesium chloride which he had at the end of the series of operations with the quantity which he had at the beginning, Mr. Frederick Chance found that the average loss of magnesia corresponded to 1.05 parts of MgO per 100 parts of waste treated. Now, while in the waste produced at Oldbury there is no magnesia to speak of, a very pure limestone being used there for making black-ash, there is reason to believe that the waste produced in the Newcastle district—the limestone of which district is all more or less magnesian—contains fully enough magnesia to make up this amount of loss, without the addition of any magnesium compound specially for that purpose. All that should be needed, therefore, in the case of Newcastle waste, should be to add from time to time the quantity of calcium chloride necessary to convert into magnesium chloride, by the aid of CO_2 , the magnesia actually existing in the waste itself. In other cases, the loss of magnesia in the Schaffner and Helbig process might be made up by replacing two or three per cent of the limestone used for making black-ash by dolomite. This is supposing, of course, that the calcium carbonate recovered in the process is not used again in black-ash making. In proportion as this recovered carbonate can be used again for making black-ash, there will be no loss of magnesia, the magnesia "lost" in one operation coming round again in the next.

The experiments of Mr. Frederick Chance further brought out the important fact that the reaction by which magnesium chloride and calcium carbonate are recovered takes place—at any rate under the conditions under which he operated, *i.e.*, under a pressure of twenty pounds per square inch,—quite as readily when the mixture treated by CO_2 is hot as when that mixture is cold. It has been supposed that that reaction depends upon the formation of bicarbonate of magnesia, in which case the mixture in question would have required to be cooled before being treated by CO_2 , and so to cool it would have been at least troublesome. It seems, however, that the reaction in question is really a reaction between CaCl_2 and MgCO_3 . This result is confirmed by the result obtained by Dr. Hewitt by simply mixing with solution of CaCl_2 an equivalent of the carbonate of magnesia of the shops. He obtained in that way a decomposition of about 80 per cent of his calcium chloride, and it is probable that the carbonate of magnesia he employed did not contain more than that percentage of MgCO_3 .

Mr. Frederick Chance further lighted upon a very curious fact, which is valuable as affording to the workmen a simple and ready indication of the moment at which the regeneration of the magnesium chloride has become complete. In the mixture operated upon there is always a little ferrous sulphide. This ferrous sulphide is not acted upon by CO_2 so long as there is any free magnesia present, but it is attacked so soon as all magnesia present has

become carbonated, with the result of sending iron into solution as acid ferrous carbonate. The presence of the iron which thus comes into solution can be very readily detected, and the moment it appears the workmen in charge know that it is time to stop injecting CO_2 .

In the South of France experiments are now being made, at my instance, with a modification of the Schaffner and Helbig process. The first time I visited Cornwall, now very many years ago, I was on one occasion at a dinner-table at which I was asked to name "the four Cornish minerals." To name two of them was not difficult, but my endeavours to name the other two only created most Homeric laughter. At length I was informed that "the four Cornish minerals" are "fish, copper, potatoes, and tin." Cornwall being a mining county, for a Cornishman every natural production which he turns to useful account is a "mineral." At a banquet given by him at Giraud, in May last, to the members of the "Société de l'Industrie Minérale,"—the French "iron and Steel Institute,"—M. Pechiney, addressing miners and metallurgists, similarly spoke of sea-water as "notre minéral à nous;" and the object of the modification in question is to turn to account in two ways one of the constituents of that extremely complex liquid ore, namely, its magnesium chloride. Most of those in France who make salt from sea-water content themselves with obtaining therefrom only common salt, but M. Pechiney treats the mother-liquors from which as much NaCl as possible has been crystallised out for the further obtainment from them of sodium sulphate, magnesium sulphate, and potassium chloride, and his final residue is a saturated solution of magnesium chloride, containing no other body except magnesium bromide. It has seemed to me that this magnesium chloride might be utilised at once for the recovery of sulphur from soda-waste, and as a source of magnesia for sale as such. When alkali-waste, however, is treated directly by solution of magnesium chloride, the magnesium hydrate, which is one of the products of the reaction which takes place, is obtained in admixture with all the numerous bodies other than calcium sulphide which were contained in the waste treated. When the magnesium hydrate is to be employed for the regeneration of magnesium chloride, this presence with it of foreign bodies does not matter; but in cases in which regeneration of the magnesium chloride used is not necessary, while it is desired to obtain magnesium hydrate for sale, the presence of foreign bodies with the magnesium hydrate must be avoided. I propose to avoid it by taking advantage of a reaction which is known as Kraushaar's, from its having been first published, in *Dingler's Journal* for 1877, by Dr. Kraushaar, of Thann, but which was really discovered by Mr. Helbig, at Aussig, and turned by him to practical account there as early as 1874. This is the reaction which takes place when alkali-waste is heated with water under pressure. It is a reaction of two of water upon two of calcium sulphide, giving one of calcium hydrate and one of calcium sulphhydrate. The calcium sulphhydrate is obtained in solution, and if this solution be separated from the calcium hydrate and other bodies which it at first holds in suspension, on then running into it solution of magnesium chloride there is obtained, on the one hand, H_2S , and on the other, magnesium hydrate, almost chemically pure. And it is to be noted that, whereas when alkali-waste is treated directly with solution of magnesium chloride only one of H_2S is obtained for each equivalent of MgCl_2 which enters into reaction, by first getting the sulphur of the waste into the state of calcium sulphhydrate two equivalents of H_2S are obtained for each equivalent of magnesium chloride decomposed.

At one time I had some hope that one might take advantage in England of this reaction of two of water upon two of waste, to the end of reducing by one-half the quantity of magnesium chloride to be employed, and consequently the quantity of that body to be recovered, per given quantity of alkali-waste treated. Mr. Chance was so obliging as to make some experiments on this point at Oldbury, and Mr. Helbig made others at Aussig, and the

result of both series of experiments went to show that the idea is not applicable, or at any rate not applicable with any great advantage, when the magnesium chloride employed has to be regenerated. The reason is that the whole of the sulphur of the calcium sulphide of the waste which is heated with water under pressure does not come into solution unless a certain minimum quantity of water be used. This quantity of water is not too great to permit of the method being employed with advantage when the magnesium chloride has not to be recovered. But, when it has to be recovered, all this water would have afterwards to be driven off by evaporation, or the regenerated magnesium chloride would be impracticably dilute; and the cost of this additional evaporation would probably balance the economy due to halving the quantity of magnesium chloride to be dealt with.

Some attention has been drawn recently to a second Austrian method of recovering sulphur from alkali-waste: a method proposed by Herr Opl, of the chemical works of Hruschau, in Moravia. This gentleman proposes to mix waste with water, to treat the mixture with CO_2 and so drive off H_2S from it, and then to pass this H_2S into more mixture of waste with water, in order that it shall be absorbed by the calcium sulphide of this second quantity of waste with formation of solution of calcium sulphhydrate, which could then be treated in any one of several ways. This proposal seems to me defective, for the reason, among others, that I do not see how it would be practicable to avoid sending an excess of CO_2 into the second quantity of mixture of waste and water, which excess of CO_2 would react on some of the calcium sulphhydrate formed in that second quantity of such mixture, driving off H_2S , and so occasioning both loss of sulphur and nuisance. Certainly, Herr Opl's method of getting the sulphur of alkali-waste into solution as calcium sulphhydrate cannot, I think, compete with the simpler method of heating the waste with water under pressure.

Here, at last, I draw this too long paper to a close. I have had to show in it that the immediate future of the English Leblanc soda industry is somewhat gloomy; but I trust that I have shown also reason to believe that sufficient attention to the complete utilisation of all raw materials is yet capable of saving it. Very much has yet to be done before it will be placed once more on a satisfactory basis; but *nil desperandum!* Patient courage and wisely-directed labour will bring all right again in time. A French Leblanc soda-maker, discussing in Paris, recently, "l'affaire de Rio Tinto," spoke very hopelessly at first, but suddenly his countenance brightened, and he said: "*Mais, courage!*" This is not the first time, nor the second, since I have been in the trade, that we have been menaced with apparently unavoidable ruin; but we have always pulled through before, and we will pull through again." That is a spirit on which we in England specially pride ourselves; and in whatever "pluck," combined with intelligence, can do,—and in this case I believe that they can do all that is required,—I am confident that my countrymen will not be left behind.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 15, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

It was announced that a ballot for the election of Fellows would be held at the next meeting (March 1).

The following certificate was read for the first time:—
W. H. Cameron.

The list of Officers as proposed by the Council was read from the Chair: Prof. G. D. Liveing and Dr. A. Voelcker

are proposed as Vice-Presidents instead of Prof. J. Dewar and A. V. Harcourt, who retire; in the Council, Prof. Dittmar, Dr. W. R. E. Hodgkinson, Messrs. D. Howard and R. Meldola replace Dr. T. E. Thorpe and Messrs. F. D. Brown, J. M. Thomson, and W. Thorp; Drs. Thorne and Hodgkinson and Mr. D. Howard were elected auditors.

The SECRETARY then read the following papers:—

"On some Derivatives of Diphenylene-ketone Oxide," by A. G. PERKIN. While preparing the above substance from salicylic acid and acetic anhydride, the presence of a small quantity of another body was detected in the washings. This substance the author has separated as transparent satiny plates containing 75.2 per cent C, 3.9 per cent H. Its formula has not yet been settled. By the action of a cold mixture of equal parts of nitric and sulphuric acids, and by the action of fuming nitric acid, a nitro-body was formed, $C_{15}H_6(NO_2)_2O_2$. It is very slightly soluble in boiling alcohol, and melts at $262^\circ C$. By the action of tin and hydrochloric acid on dinitro-diphenylene-ketone oxide, suspended in alcohol, a diamido-body is produced, $C_{13}H_6(NH_2)_2O_2$; it was obtained in flat orange-coloured needles. This base forms a hydrochloride and a platinum salt, which were analysed. Diphenylene-ketone oxide dissolves in cold Nordhausen acid unchanged, but on heating the solution and treating with barium carbonate, a salt was obtained having the formula $C_{13}H_6O_2Ba(SO_3)_2$. Bromine, when heated in a sealed tube with diphenylene-ketone oxide, forms a dibromobody, $C_{13}H_6Br_2O_2$.

"On a Ethyl-valero-lacton, α -Ethyl- β -methyl-valcro-lacton, and on a Remarkable Decomposition of β -Ethyl-aceto-succinic Ether," by S. YOUNG. Fittig and Krafft (*Annalen*, 208, 71) prepared a hepto-lacton of unknown constitution. The author, at the suggestion of Prof. Fittig, undertook the preparation of a hepto-lacton of known constitution. A mixture of 10 grms. of sodium, 100 grms. of alcohol, 58 grms. of aceto-acetic ether, and 87 grms. of α -bromo-butyric ether, was heated in a water-bath for two days. The author could not obtain a product of constant boiling-point. About 12 grms. of the portion boiling at from 250° to 260° was boiled with twice its weight of 33 per cent hydrochloric acid. The resulting product was principally α -ethyl- β -aceto-propionic acid, which was extracted with ether, and the latter distilled off. The residue partially crystallised at low temperatures. A portion was warmed with sodium amalgam, acidified with sulphuric acid, and boiled, made alkaline with potassium carbonate, and extracted with ether; the ether extract on distillation gave a residue which eventually, after fractionation, proved to be the lacton, boiling at 219.5° . Analysis indicated the formula $C_7H_{12}O_2$. It did not solidify in a mixture of snow and salt. On dissolving this substance in the smallest possible quantity of ice-cold water, a clear solution was obtained, which became turbid at 17° up to 90° , &c. By boiling the lacton with barium hydrate, barium and ethyl-oxvalerate was prepared: the silver salt was also obtained and analysed. When either salt is decomposed by an acid a mixture of lacton and oxy-acid is formed. On preparing larger quantities of the crystalline acid, which the author calls ketolactonic acid, the distillate at higher temperatures, above 265° , yielded proportionately more crystals than that between 250° to 260° , so that the decomposition apparently takes place during distillation, and not during saponification. The barium and silver salts of this ketolactonic acid were prepared and analysed. By the action of barium hydrate on ketolactonic acid a derived acid was prepared, whose silver salt had the composition $C_8H_{10}O_5Ag_2$. Thorne obtained by the saponification of β -ethyl-aceto-succinic ether, α -ethyl- β -aceto-propionic acid and ethyl-succinic acid. The author separated, in addition, this new ketolactonic acid. α -ethyl- β -methyl-valerolacton was also prepared by the distillation of β -ethyl-aceto-methyl-succinic ether. Thorne, by the distillation of α -ethyl- β -propionic acid, obtained an anhydride which he stated to be insoluble in water. The author has repeated these experiments, and

obtained the anhydride, which is, however, slightly soluble in water. In conclusion, the constitution of ketolactonic acid is discussed.

Dr. THORNE said that he was able to distil the β -ethyl-aceto-succinic ether *in vacuo* at 263° to 264° without decomposition. As to the anhydride, he had since found that it was slightly soluble in water. At the time he first prepared the substance he had but a very small quantity at his disposal.

The Society then adjourned to March 1, when a ballot for the election of Fellows will be held, and the following paper read:—"On some Derivatives of the Isomeric $C_{10}H_{14}O$ Phenols," by Dr. Armstrong and E. H. Rennie.

PHYSICAL SOCIETY.

Annual General Meeting, February 10th, 1883.

Professor FULLER in the Chair.

NEW Officers elected for the year:—

President—Prof. R. B. Clifton, M.A., F.R.S.

Vice-Presidents—Sir W. Thomson, F.R.S.; Prof. G. C. Foster, F.R.S.; Dr. J. Hopkinson, F.R.S.; Lord Rayleigh, F.R.S.; Prof. W. C. Roberts, F.R.S.

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Other Members of Council—Prof. W. G. Adams, M.A., F.R.S.; Prof. W. E. Ayrton, F.R.S.; Mr. Shelford Bidwell, M.A., LL.B.; Mr. W. H. M. Christie, M.A., F.R.S.; Prof. F. Fuller, M.A.; Mr. R. T. Glazebrook, M.A., F.R.S.; Mr. R. J. Lecky, F.R.A.S.; Prof. O. J. Lodge, D.Sc.; Mr. Hugo Müller, Ph.D., F.R.S.; Prof. J. Perry. New Member—Prof. Blyth, of Anderson's College, Glasgow.

Prof. SILVANUS P. THOMPSON explained his new graphical method of showing Jacobi's law of maximum rate of working, and Siemens's law of efficiency for dynamo-electric machines. This has been fully explained in the *Philosophical Magazine*, and in the Cantor Lectures on "Dynamo-Electric Machinery" delivered by Prof. Thompson.

Prof. W. G. ADAMS pointed out the advantages of a graphic system of the kind.

CORRESPONDENCE.

THE DETERMINATION OF NITRIC ACID IN MANURES BY THE CRUM METHOD.

To the Editor of the Chemical News.

SIR,—Referring to Mr. Shepherd's paper in the *CHEMICAL NEWS*, vol. xlvii., p. 75, describing the determination of nitric acid in manures by the Crum method, he directs that the weighed portion "be extracted with boiling water and filtered, the filtrate and washings evaporated to a small bulk, &c." Having used the method for a long time past, my experience is that filtration is unnecessary, and boiling and evaporating decidedly to be avoided, as manures invariably contain sufficient free acid to react upon the nitrate at a temperature above $90^\circ C$. I simply extract about 50 grains with warm water, make the solution up to a certain measure (say 1000 grains), and take 100 grains of this for a determination. I have also always found an equal volume of o. v. ample.

Mr. Shepherd further on says—"Usually some carbonic acid and other gases are given off" on mixing the liquids. I cannot understand from whence the carbonic acid will

come, and in his case an alkaline carbonate. I think usually he will find the other gases largely predominate, and consist essentially of oxides of nitrogen.

With regard to compensating for the weight of the column of acid, this can be accurately done by placing water in the cup or funnel of the nitrometer and cautiously opening the stopcock. Should the gas be under pressure from within, the bubble which rises may be caught in the aperture of the stopcock, the pressure reversed, and the bubble returned to the nitrometer, together with some water, then either letting water cautiously in until the levels are equalised, or by raising the mercury reservoir until the water in the funnel remains stationary on opening the stopcock.—I am, &c.,

H. B. YARDLEY.

Odum's Wharf, Victoria Docks,
London, February 19, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 1, January 2, 1883.

Memoir on the Vision of Material Colours in Rotatory Movement, and on the Respective Speed, estimated in Figures, of Circles of which one Diameter Half is Coloured and the other Half White; Speeds Corresponding to three Periods of their Movement, from the Extreme Speed to Rest.—E. Chevreul.—This paper is not capable of useful abstraction.

Researches on the Hyponitrites: First Part—Chemical Researches.—MM. Berthelot and Ogier.—Silver hyponitrite has received the formula NO_2Ag . The authors deduce from their analyses the formula $\text{N}_2\text{O}_5\text{Ag}_2$. Hyponitrous acid is, therefore, a sesqui-oxide of nitrogen, having, in the anhydrous state, the composition N_2O_3 .

Decomposition of Formic Acid by the Effluve.—M. Maquenne.—The apparatus used consisted of a Berthelot's effluve tube containing 10 to 15 grms. of monohydrated formic acid. The results are carbon monoxide and dioxide and hydrogen, and some traces of carbides. The results are identical with those obtained by M. Berthelot on decomposing formic acid by heat alone in a closed vessel.

Pyro-sulphuryl Chloride.—J. Ogier.—The author, in common with M. Rosenstiehl, and in opposition to M. Konowaloff, finds that the vapour-density of sulphuryl chloride is one-half less than the law of Avogadro would require. He refutes the explanation proposed by M. Konowaloff to account for the discrepancy of their respective determinations. He shows that the substance upon which he operated was certainly pyro-sulphuryl chloride, and that it did not contain a notable quantity, such as three-quarters of the compound $\text{S}_2\text{O}_6\text{HCl}$; that the substance weighed in the density flasks had the same composition as that taken for the experiment, and that it had not been dissociated.

Existence of Zinc in a State of Diffusion in Dolomitic Districts.—M. Dieulafait.—From the presence of ammonia, and occasionally of bitumen, in dolomites the author concludes that they are not merely sedimentary rocks, but that they have been produced in waters very rich in organic matters, *i.e.*, in land-locked bays or in estuaries. He has previously shown that zinc is still being concentrated in the estuaries of the modern era, and points to the close connection between magnesium and zinc. Hence it might be expected, as actually occurs, that zinc would be found in magnesian rocks.

No. 2, January 8, 1883.

Researches on the Hyponitrites: Second Part—Calorimetric Measurements.—MM. Berthelot and Ogier.—A thermo-chemical memoir which does not admit of useful abridgment.

Natural Formation of Manganese Dioxide, and Certain Reactions of the Peroxides.—M. Berthelot.—The author remarks that the opposition between those metallic peroxides which furnish oxygenated water under the influence of acids and those which do not, is the real experimental foundation of the celebrated theory of ozonides and antozonides. It is explained by thermic considerations correlative to those which determine the displacement of carbonic acid in the carbonates by free oxygen.

Examination of the Analogy between the Electro-Chemical and the Hydro-dynamical Rings and the Curves $\Delta V = 0$.—M. Ledieu.—The author points out certain fundamental differences between the two classes of rings.

Influence of Refrigeration upon the Value of the Maximum Pressures developed in Closed Vessels by Explosive Gases.—M. Vieille.

Remarks on the Expression of Electric Magnitudes in the Electrostatic and Electromagnetic Systems, and the Relations thence Deduced.—MM. E. Mercadier and Vaschy.—Two mathematical papers, not susceptible of useful abstraction.

Phosphorography of the Ultra-Red Region of the Solar Spectrum: Wave-lengths of the Principal Rays.—Henri Becquerel.—The principal facts resulting from the author's researches are, besides the determination of new rays in the solar spectrum and of their wave-length, the observation in the ultra-red spectrum of maxima and minima of extinction peculiar to various phosphorescent substances.

Solar Photometry.—M. Crova.—The author gives the intensity of the sun's light in a clear sky at about 8500 carrels.

Manganese in Dolomitic Regions: Origin of the Nitric Acid sometimes found in Native Manganese Peroxides.—M. Dieulafait.—The author finds that manganese as well as zinc is linked to magnesia. In 144 dolomitic rocks in which he had observed zinc, manganese was likewise detected, whilst in 42 non-magnesian calcareous rocks it was absent. There are two classes of manganese ores; the former, derived from the action of sea-water upon the primordial rocks, are invariably associated with barium sulphate. The manganese ores of the second class are always poor in baryta.

Zeitschrift für Analytische Chemie.

Vol. xxi., Part 4, 1882.

General Analytical Methods, Operations, Apparatus, and Reagents.—Concerning the hygroscopic power of various substances, W. Müller-Erzbach finds that phosphoric anhydride, concentrated sulphuric acid, and dehydrated potassa differ little in their power of attracting water. Caustic soda and calcium chloride differ mutually little, but do not retain water as firmly as phosphoric anhydride or potassa.

A. Rollett describes a "polarispectro-microscope." It consists of an ordinary microscope with a small direct vision spectroscopic placed below the stage, and beneath this, again, a polarising prism.

Fuch and Ricco propose modified prisms, which cannot be described without the aid of the accompanying figures.

Phenacetoline, proposed as an alkalimetric indicator by Paul Degener, is tinged very faintly yellowish by caustic alkalies and alkaline earths; with the carbonates it forms a full red compound, soluble in case of alkalies, but insoluble in the alkaline earths. With acids, phenacetoline

is coloured a distinct golden yellow. With sodium sulphide it behaves as with sodium carbonate, and is also reddened by ammonia.

K. Tumsky has experimented with phenol phthaleine as an indicator, and infers that it is less sensitive than litmus, and is not affected by ammoniacal vapours and dilute solutions of alkaline carbonates.

O. Miller, S. Prochorow, and P. Wisocky pronounce phenol phthaleine a good indicator when pure, but useless when impure.

Fr. Stolba proposes the following method for the preparation of azolitmine: Clean linen or cotton cloth is saturated in common tincture of litmus, washed in common water, and then in distilled water. The colour is then stripped by a passage in distilled water to which a few drops of very weak soda-lye have been added. The deep blue liquid thus obtained is cautiously neutralised by the addition of dilute sulphuric acid.

Preparation of Metallic Copper for Organic Analysis.—Th. Weyl.—The author exposes cupric oxide, moderately heated in a combustion-tube, to the vapour of formic acid.

Chemical Analysis of Inorganic Bodies.—E. Hintz.

Spectrum of Magnesium.—G. D. Liveing and J. Dewar.—From the *Proceedings of the Royal Society*.

Sensitive Reagent for Gaseous Ammonia.—Gustav Kroupa.—The author dissolves magenta in water and adds dilute sulphuric acid until the yellowish colour passes into a yellowish brown. Unsized paper is saturated with this solution, and then appears yellow, but if exposed to the vapour of ammonia it takes a crimson colour. The paper must be preserved in stoppered bottles.

Solubility of Strontia in Water.—C. Scheibler and D. Sidersky.—The authors find that a saturated solution of strontia (hydrated) at 0° contains 0.35 per cent SrO, but at 101.2°, 19.34 per cent.

Separation of Magnesia from Lime, Ferric Oxide, and Alkalies.—H. Hager.—Will be inserted in full.

Detection of Cobalt in Presence of Iron and Nickel. C. H. Wolff.—For the quantitative determination of minimum quantities of cobalt C. H. Wolff recommends the characteristic absorption-spectrum of the blue solution obtained on mixing a neutral alcoholic solution of cobaltous chloride or nitrate with an alcoholic solution of ammonium sulphocyanide. In order to apply this process to the detection of cobalt in presence of iron and nickel, H. W. Vogel combines it with C. Zimmerman's method of separation, based on the fact that from a mixed solution, containing nickelous, cobaltous, and ferric sulphocyanides, the iron is thrown down as ferric hydrate by the addition of neutral sodium carbonate. Vogel adds to the solution, sodium carbonate till the red colour disappears, filters, and shakes the filtrate in a test-tube with a mixture of equal volumes of amyl alcohol and ether. This mixture takes up the cobaltous sulphocyanide, and separates as a blue stratum floating above the watery liquid. If nickel is also present the ethereal liquid is not blue, but green. If the liquid is examined in the spectroscope the presence of cobalt is distinguished by the absorption-band between C and D.

Determination of Small Quantities of Arsenic in Sulphur.—H. Schäppi.—The sulphur, finely ground, is covered with hot water, to which a few drops of nitric acid have been added in order to remove calcium chloride and sulphate, and to decompose calcium sulphide. It is digested, filtered, and washed till the washings do not react acid. The sulphur is then digested for a quarter of an hour at 70° to 80° with water containing a few drops of pure ammonia. The solution, containing all the arsenic sulphide, is mixed with silver nitrate, and all the sulphur present as arsenic sulphide is deposited as silver sulphide. For its determination the liquid is acidulated with dilute nitric acid, dissolved in hot nitric acid, hydrochloric acid is added, and the precipitated silver chloride is weighed. Three equivalents of silver chloride correspond to one

equivalent of arsenic tersulphide. According to Hager arsenic may be present in sulphur as arsenious acid. In this form it will escape determination by the process in question.

Determination of Tungstic Acid in Presence of Alkalies.—Wolcott Gibbs.—From the *American Chemical Journal*.

Determination of Phosphoric Acid.—R. Finkener.—The author proposes a method for the direct determination of phosphoric acid from the weight of the phosphomolybdic precipitate. The following conditions must be observed in precipitation: The solution must contain a sufficiency of free nitric acid. The molybdic solution added must be fourfold the volume of the phosphoric solution to be precipitated, and at least one-third of the molybdic acid added must be in excess of the quantity required for combination with the phosphoric acid. In every 100 c.c. of the volume of liquid after the addition of the molybdic solution must be dissolved 25 grms. ammonium nitrate. The precipitate of ammonium molybdate is filtered after standing for twelve hours, and is washed with a 20 per cent solution of ammonium nitrate, to which at the beginning of the washing 1-30th of its bulk of nitric acid is added. After removal of the greater part of the ammonium nitrate by means of water the contents of the filter are rinsed into a porcelain crucible, the matter adhering to the paper is dissolved in hot dilute ammonia, the solution is concentrated by evaporation, an excess of nitric acid is added, the solution is poured into the porcelain crucible, the liquid is evaporated away, and the ammonium nitrate expelled by gently heating over a flame placed below a wire gauze. The volatilisation of the ammonium nitrate is found to be complete when a cold watch-glass placed over the crucible is not clouded. The ammonium phospho-molybdate is not decomposed if a needlessly high temperature is avoided. The residue is hygroscopic, and must be cooled in the desiccator over sulphuric acid, and quickly weighed in a covered crucible. The residue is said to contain 3.794 per cent phosphoric acid. O. Hehner, in the *Analyst* (iv., p. 23), criticises this process, and proposes a modification. A. Atterberg has determined the conditions in which the most rapid and complete separation of the ammonium phospho-molybdate can be effected. He finds that by boiling the solution with molybdic acid solution the phosphoric acid is precipitated in a satisfactory manner. The boiling is effected in a beaker of moderate size, stirring continually to prevent bumping. The heat is obtained from a naked lamp flame beneath a wire gauze. The precipitate settles very quickly, and can be at once submitted to further treatment.

Determination of Phosphoric Acid combined with Lime and Magnesia.—E. Perrot.—From the *Comptes Rendus*.

MISCELLANEOUS.

The Chemical Laboratory of Wiesbaden.—The Chemical Laboratory of this place still enjoys a very large attendance. Besides the Director, Geh. Hofrath, and Dr. R. Fresenius, there are engaged as teachers in the establishment, Dr. H. Fresenius, Dr. E. Borgmann, Dr. W. Fresenius, Dr. E. Hintz, and Architect Brahm. The Assistants are twelve in number in the Private Laboratory, two in the Instruction Laboratory, and in the Versuchsstation two in the winter term 1882-83. In this term there were 60 students on the books. Of these 44 were from Germany, 5 from England, 5 from North America, 1 from South America, 1 from Luxemburg, 1 from Austro-Hungary, 1 from Sweden, 1 from Russia, and 1 from Spain. During the last term, besides the scientific researches, a great number of analyses were undertaken in the Laboratory and the Versuchsstation on behalf of manufacture, trade, mining, and agriculture.

British Mining.—Messrs. Crosby Lockwood and Co. have in active preparation and will publish, it is hoped, in the autumn, an extensive work on British Mining by Mr. Robert Hunt, the well-known Keeper of Mining Records. The book will, we are informed, comprise a thoroughly practical treatise on the metalliferous mines and minerals of the United Kingdom, dealing comprehensively with the theories of mineral deposits, the history of mines, their practical working, and the future prospects of British mining industry. The work will be fully illustrated. A most intimate connection with the mines and miners of the United Kingdom, extending over nearly forty years, and the collection and compilation of the "Mineral Statistics" for thirty-five years, must necessarily have given Mr. Hunt an insight into the theory and practice of all that relates to metalliferous mining which few other persons can possess, and we may therefore expect that the subject will receive the most ample treatment at his hands.

MEETINGS FOR THE WEEK.

- SATURDAY, 24th.**—Physical, 3. "Optical Combinations of Crystalline Films," by Lewis Wright. "Experimental Demonstration of the Vortice Theory of the Formation of a Solar System," by Philip Braham.
- MONDAY, Feb. 26.**—London Institution, 5.
Medical, 8.30.
Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field.
- TUESDAY, 27th.**—Royal Institution, 3. "The Supreme Discoveries in Astronomy (The Sun no more than a Star, the Stars no less than Suns)," by Professor R. S. Ball.
Institution of Civil Engineers, 8.
Royal Medical and Chirurgical, 8.30.
Society of Arts, 8. "Egypt, Present and to Come," by Mr. Robert W. Felkin.
- WEDNESDAY, 22th.**—Society of Arts, 8. "The Increasing Destruction of Life and Property by Fire—What is the Remedy?" by Mr. Cornelius Walford.
- THURSDAY, March 1st.**—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.
London Institution, 7.
Royal, 4.30.
Medical and Chirurgical, 8. (Anniversary).
Chemical, 8. Ballot for Election of Fellows.
"On some Derivatives of the Isomeric $C_{10}H_{14}O$ Phenols," by H. E. Armstrong Ph.D., and E. H. Rennie.
- FRIDAY, 2nd.**—Royal Institution, 8. "Meters for Power and Electricity," by Mr. C. V. Boys, at 9.
Society of Arts, 8. "Agriculture in Lower Bengal, with some Notice of Tenant-Right, &c." by W. S. Seton-Karr.
Geologists' Association, 8.
- SATURDAY, 3rd.**—Royal Institution, 3. "Singing, Speaking, Stammering," by Dr. W. H. Stone.

TO CORRESPONDENTS.

S. B.—We are not able to give the desired information. An advertisement in our columns would doubtless obtain it.

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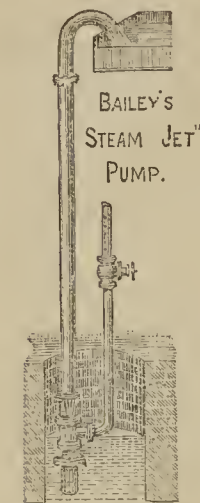
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1214.

NOTE ON TERRESTRIAL RADIATION.*

By JOHN TYNDALL, F.R.S.

ON Hind Head, a fine moorland plateau about three miles from Haslemere, with an elevation of 900 feet above the sea, I have recently erected a small iron hut, which forms, not only a place of rest, but an extremely suitable station for meteorological observations. Here, since the beginning of last November, I have continued to record from time to time the temperature of the earth's surface as compared with that of the air above the surface. My object was to apply, if possible, the results which my experiments had established regarding the action of aqueous vapour upon radiant heat.

Two stout poles about 6 feet high were firmly fixed in the earth 8 feet asunder. From one pole to the other was stretched a string, from the centre of which the air thermometer was suspended. Its bulb was 4 feet above the earth. The surface thermometer was placed upon a layer of cotton-wool, on a spot cleared of heather, which thickly covered the rest of the ground. The outlook from the thermometers was free and extensive; with the exception of the iron hut just referred to there was no house near, the hut being about 50 yards distant from the thermometers.

On November 11th, at 5.45 P.M., these were placed in position, and observed from time to time afterwards. Here are the results:—

6 P.M.	..	Air 36° F.	..	..	Wool 26° F.
8.10	..	.. 36	..	..	.. 25
9.15	..	.. 36	..	..	.. 25

Air almost dead calm, sky clear, and stars shining.

November 12th, the wind had veered to the east, and was rather strong. The thermometers, exposed at 5 P.M., yielded the following results:—

5.15 P.M.	..	..	Air 38°	..	..	Wool 33°
5.45	..	..	.. 38	..	..	.. 34
6.45	..	..	.. 38	..	..	.. 35
9	..	..	.. 39	..	..	.. 36

During the first and last of these observations the sky was entirely overcast, during the other two a few stars were dimly visible.

On November 13th, 25th, and 26th, observations were also made, but they presented nothing remarkable.

It was otherwise, however, on December 10th. On the morning of that day the temperature was very low, snow a foot deep covered the heather, while there was a very light movement of the air from the north-east. Assuming aqueous vapour to play the part that I have ascribed to it, the conditions were exactly such as would entitle us on *a priori* grounds to expect a considerable waste of the earth's heat. At 8.5 A.M. the thermometers were placed in position, having left the hut at a common temperature of 35°. The cotton-wool on which the surface thermometer was laid was of the same temperature. A single minute's exposure sufficed to establish a difference of 5° between the two thermometers. The following observations were then made:—

8.10 A.M.	..	..	Air 29°	..	..	Wool 16°
8.15	..	..	.. 29	..	..	.. 12

Thus, in ten minutes, a difference of no less than 17° had established itself between the two thermometers.

Up to this time the sun was invisible: a dense dark cloud, resting on the opposite ridge of Blackdown, virtually retarded his rising.

8.20 A.M.	..	..	Air 27°	..	..	Wool 12°
8.30	..	..	.. 26	..	..	.. 11
8.40	..	..	.. 26	..	..	.. 10
8.45	..	..	.. 27	..	..	.. 11
8.50	..	..	.. 29	..	..	.. 11

During the last two observations, the newly risen sun shone upon the air thermometer. As the day advanced the difference between air and wool became gradually less. From 18° at 8.50 A.M., it had sunk at 9.25 to 15°, at 9.50 to 13°, while at 10.25, the sun being unclouded at the time, the difference was 11°; the air at that hour being 31° and the wool 20°.

In the celebrated experiments of Patrick Wilson, the greatest difference observed between a surface of snow and the air 2 feet above the snow, was 16°; while the greatest difference noticed by Wells during his long continued observations, fell short of this amount. Had Wilson employed swandown or cotton-wool, and had he placed his thermometer 4 feet instead of 2 feet above the surface, his difference would probably have surpassed mine, for his temperatures were much lower than those observed by me. There is, however, considerable similarity in the conditions under which we operated. Snow in both cases was on the ground, and with him, as with me, there was a slight movement of the air from the north-east. The great differences of temperature between earth and air which both his observations and mine reveal, are due to a common cause, namely, the withdrawal of the check to terrestrial radiation which is imposed by the presence of aqueous vapour.

Let us now compare these results with others obtained at a time of extreme atmospheric serenity, when the air was almost a dead calm, and the sky without a cloud. At 3.30 P.M., January 16th, the thermometers were placed in position, and observed afterwards with the following results:—

3.40 P.M.	..	..	Air 43°	..	..	Wool 37°
3.50	..	..	.. 42	..	..	.. 35
4	..	..	.. 41	..	..	.. 35
4.15	..	..	.. 40	..	..	.. 34
4.30	..	..	.. 38	..	..	.. 32
5	..	..	.. 37	..	..	.. 28
5.30	..	..	.. 37	..	..	.. 30
6	..	..	.. 36	..	..	.. 32

These observations, and especially the last of them, merit our attention. There was no visible impediment to terrestrial radiation. The sky was extremely clear, the moon was shining; Orion, the Pleiades, Charles's Wain, including the small companion star at the bend of the shaft, the north star, and many others, were clearly visible. On no previous occasion during these observations had I seen the firmament purer; and still, under these favourable conditions, the difference between air and wool at 6 P.M. was only 4°, or less than one-fourth of that observed on the morning of the 10th of December.

We have here, I submit, a very striking illustration of the action of that invisible constituent of the atmosphere, to the influence of which I drew attention more than twenty-two years ago. On the 10th of December the wind was light from the north-east, with a low temperature. On the 16th of January it was very light from the south-west, with a higher temperature. The one was a dry air, the other was a humid air; the latter, therefore, though of great optical transparency, proved competent to arrest the invisible heat of the earth.

The variations in the temperatures of the wool recorded in the last column of figures are, moreover, not without a cause. The advance of temperature from 28° at 5 P.M. to 32° at 6 P.M., is not to be accounted for by any visible change in the atmosphere, or by any alteration in the motion of the air. The advance was due to the intrusion

* A Paper read before the Royal Society, Feb. 8, 1883.

at 6 P.M. of an invisible screen between the earth and firmament.

As the night advanced, the serenity of the air became, if possible, more perfect, and the observations were continued with the following results:—

6.30 P.M.	..	..	Air 36°	..	..	Wool 31°
7	..	..	36	..	..	28
7.30	..	..	35½	..	..	28
8	..	..	35	..	..	26
8.30	..	..	34	..	..	25
9	..	..	35	..	..	27
10	..	..	35	..	..	28
10.30	..	..	35	..	..	29

After this last observation, my notes contain the remark "Atmosphere exquisitely clear. From zenith to horizon cloudless all round."

Here, again, the difference of 4° between the temperature of the wool at 8.30 P.M., and its temperature at 10.30 P.M., is not to be referred to any sensible change in the condition of the atmosphere.

The observations were continued on January 17th, 23rd, 24th, 25th, and 30th; but I will confine myself to the results obtained on the evening of the day last mentioned. The thermometers were exposed at 6.45 P.M., and by aid of a lamp read off from time to time afterwards.

7.15 P.M.	..	..	Air 32°	..	..	Wool 26°
8	..	..	„ 31	..	..	„ 26
9.30	..	..	„ 31	..	..	„ 27

During these observations the atmosphere was very serene. There was no moon, but the firmament was powdered with stars. The serenity, however, had been preceded by heavy rain, which doubtless had left the atmosphere charged with aqueous vapour. The movement of the air was from the south-west and light. Here again, with an atmosphere at least as clear as that on December 10th, the difference between air and wool did not amount to one-fourth of that observed on the latter occasion.

The results obtained on February 3rd were corroborative. The thermometers were exposed at 6.15 P.M.

7.15 P.M.	..	..	Air 34°	..	..	Wool 28°
8.25	..	..	„ 34	..	..	„ 30

Here again, the difference between air and wool is only 4 degrees, although the sky was cloudless, and the stars were bright. The movement of the air was from the south-west and light.

On the forenoon of this day there had been a heavy and persistent rain storm. Heavy rain and high wind also occurred on the night following. The serene interval during which the observations were made lay, therefore, between the two storms. Doubtless the gap was well filled with pure aqueous vapour.

Further observations were made in considerable numbers, but they need not here be dwelt upon, my object being to illustrate a principle rather than to add to the multitudinous records of meteorology. It will be sufficient to say, that with atmospheric conditions sensibly alike, the waste of heat from the earth varies from day to day; a result due to the action of a body which escapes the sense of vision. It is hardly necessary for me to repeat here my references to the observations of Leslie, Hennessey, and others, which revealed variations in the earth's emission for which the observers could not account. A close inspection of the observations of the late Principal Forbes on the Faulhorn, proves, I think, that the action of aqueous vapour came there into play, and his detection of this action, while unacquainted with its cause, is, in my opinion, a cogent proof of the accuracy of his work as a meteorologist.

POSTSCRIPT.

In the *Philosophical Transactions* for 1882, Part I., p. 348, I refer to certain experiments executed by Professor Soret, of Geneva. My friend has recently

drawn my attention to a communication made by him to the French Association for the Advancement of Science, in 1872. It gives me great pleasure to cite here the conclusions at which he has arrived.

"The influence of humidity is shown by the whole of the observations; and it may be stated generally, that, other circumstances being equal, the greater the tension of aqueous vapour, the less intense is the radiation.

"In winter, when the air is drier, the radiation is much more intense than in summer, for the same height of the sun above the horizon.

"On several occasions a more intense radiation has been observed in dry than in humid weather, although the atmosphere was incontestably purer and more transparent in the second case than in the first.

"The maximum intensity of radiation, particularly in the summer, corresponds habitually to days exceptionally cold and dry."

Such are the results of experiments executed by a most excellent observer on the radiation of the sun. They apply word for word to terrestrial radiation. They are in complete harmony with the results published by General Strachey in the *Philosophical Magazine* for 1866, while the experimental basis on which they rest was furnished several years earlier.

ON THE

ATOMIC WEIGHT OF MANGANESE.*

By JAMES DEWAR, M.A., Jacksonian Professor, Cambridge,
and ALEXANDER SCOTT, M.A.

OUR attention has been directed for some time to a new determination of the atomic weight of manganese. The present communication gives a succinct account of the results of the preliminary stages of such an inquiry; and although the further progress of the investigation may reveal some errors, still we feel convinced the final numbers can in no way differ materially from the memoranda of the present results, and therefore further delay in publication is unnecessary.

The atomic weight of manganese has been determined by many chemists, but the resulting values vary considerably according to the special method selected. These investigators may be divided into two classes—those giving approximately 55 as the number, and those making it about 54. To the former belong Turner, Berzelius, and Dumas, all of whom use the same method, viz., the determination of the silver chloride yielded by a weighed amount of chloride of manganese. Turner also made determination from the analysis of the carbonate, and from the conversion of the monoxide into sulphate; Brandes by analysing the crystallised chloride obtained the number 57. Von Hauer used the same method as that employed by him in the determination of the atomic weight of cadmium, viz., the reduction of manganous sulphate to sulphide by reduction in a current of sulphuretted hydrogen. It is probable that this method is not very trustworthy, as, according to Schneider, the sulphide may be contaminated by oxysulphide. Schneider and Rewack belong to the second class of observers, the former employing the oxalate, and from its analysis calculating the atomic weight by deducting the weight of water and carbon dioxide obtained from the original weight of salt.

Rewack, whose experiments were also conducted in Schneider's laboratory, weighed the water obtained by reducing manganous-manganic oxide to manganous oxide. One objection to the analysis of the chloride is that it may contain, besides manganous chloride, varying proportions of manganic salts. This is specially the case if, as Forchammer maintains, pure

* A Paper read before the Royal Society, Feb. 15, 1883.

TABLE I.

	Weight of Silver Permanganate.		Weight of Residue Ag+MnO.		Oxygen lost.	Equivalent.
	In air.	In vacuo.	In air.	In vacuo.		
I.	5.8688	5.8696	4.6320	4.63212	1.23748	227.673
II.	5.4981	5.4988	4.3358	4.33591	1.16293	226.965
III.	7.6725	7.6735	6.0538	6.05395	1.61959	227.422
IV.	13.0997	13.10147	10.3179	10.31815	2.78332	225.943
V.	12.5782	12.5799	{ 9.9104	9.91065	2.66925	226.22
			{ 9.9141	9.91435	2.66555	226.53

TABLE II.

No.	AgMnO ₄ .	AgMnO ₄ . Corrected for vacuo.	KBr.	KBr. Corrected for vacuo.	Equivalent of AgMnO ₄ .	Reducing Agent.
1	6.528	6.5289	3.4228	3.42385	227.094	Sulphurous acid.
2	7.5368	7.5378	3.9541	3.9553	226.958	Nitrite of potash.
3	6.1000	6.1008	3.20067	3.20166	226.937	"
4	5.7457	5.74647	3.00584	3.00677	227.606	Sulphurous acid.
5	6.1651	6.16593	3.23503	3.23602	226.918	Formate of soda.
6	5.1126	5.11329	2.68216	2.6828	226.984	"
7	5.0737	5.07438	2.6614	2.66204	227.013	Nitrite of potash.
8	13.4466	13.4484	7.05385	7.05602	226.983	"
9	12.5782	12.5799	6.59861	6.60065	226.972	Hydrogen.
10	12.2686	12.27025	6.4361	6.43808	226.976	Nitrite of potash.

manganous salts are colourless, the pink colour of manganese salts being due to traces of a manganic compound. We have, however, been unable to prepare any chloride or bromide without a pink or rose colour giving a correspondingly coloured solution; and this was also the case even when fused in hydrogen and hydrochloric acid gas. If, however, as Forchhammer says, on fusing manganese sulphate with potassium hydrogen sulphate, a white mass is obtained which gives a colourless solution, although containing a large quantity of manganese, then the effect of a trace of manganic salt in the chloride would merely be to lower the equivalent, and consequently the atomic weight. One experiment with chloride and bromide seemed to bear out this idea.

In order to ascertain the values of the atomic weight of manganese which result from careful analysis of the halogen salts, two determinations were made of the molecular weights of chloride and bromide prepared with great care. The number found from the bromide was 214.87, and from the chloride 125.825, yielding the respective atomic weights of manganese of 54.97 and 54.91.

It appeared to us that the analysis of silver permanganate might be employed with advantage, as this salt is found in a very definite state, and can be easily freed from all the allied metals. It, moreover, involved only the atomic weights of silver and oxygen; and as it seemed feasible to calculate the atomic weight of the manganese directly from the loss of oxygen on heating, without the use of any reagent and without the possibility of loss, we expected to get very accurate results. In this we were disappointed, and have not been able to obtain very concordant results by this most direct method, although we still hope to improve them.

Table I. gives the results of the direct determination of the equivalent of the permanganate of silver by reduction in hydrogen.

The silver permanganate was heated in a bulb of hard glass, first in a current of pure air and then in hydrogen, at a red-heat, until it had a constant weight. The residue consisted of silver and protoxide of manganese, and was allowed to cool in hydrogen, which was finally displaced by nitrogen before weighing. From some reason or another we have not been able to arrive at any very concordant results by this method, errors being probably due to impurities in the hydrogen or occlusion of gases in the residue. The method finally employed was to dissolve the permanganate of silver in dilute nitric acid in presence of various reducing agents, such as sulphurous acid, sodium formate, and potassium nitrite. The silver was then determined by adding very nearly an equivalent quantity of pure po-

tassium bromide, and titrating the small amount of silver remaining in solution, by means of very dilute potassium bromide, containing about 1.19 m.grms. of the pure salt per gramme of solution. The solutions were in all cases weighed, thus avoiding errors due to expansion of fluid, faulty graduation of burettes, &c. The titrations were performed in yellow light in an apparatus similar to that used by Stas, and with all the precautions insisted on by him as essential to the accuracy of such determinations.

The permanganate of silver crystallises readily from warm water, and is a very stable salt. It is also quite anhydrous and not in the slightest degree hygroscopic. From its small solubility it is easily freed from adhering impurities by re-crystallisation. The purity of the salt was tested by reducing about 5 grms. by means of alcohol and filtering, when the total residue only weighed 1.9 m.grms. This residue when tested with the spectro-scope was found to consist almost entirely of calcium from the distilled water, only the faintest trace of potassium being detected. This sample was only re-crystallised once after precipitation. The salt was usually prepared by the precipitation of silver nitrate by means of an equivalent quantity of potassium permanganate, the solutions being warm, and the silver permanganate was thus obtained in fine needles, which were very easily drained and washed.

A quantity of the salt was also prepared from crystallised barium permanganate which was made from barium chloride and silver permanganate, the barium salt being afterwards decomposed with pure silver sulphate. The method of preparing the permanganate of silver ensures the absence of any trace of silver nitrate, which, as Stas has shown, adheres most persistently to many silver salts obtained by double decomposition. The iodate is an example of this.

Permanganate of silver has several very important advantages over the other bodies previously used for the determination of the atomic weight of manganese. Its freedom from hygroscopic properties and the improbability of its containing excess of any of the elements of which it is composed beyond what is necessary for the formation of the normal compound, recommend it especially for this purpose. Another point which rendered its selection important was to ascertain if a body liable to easy decomposition under certain circumstances could give concordant results in atomic weight, determinations thus putting to a crucial test the amount of variation in the values which may be all related to secondary reactions.

The silver permanganate has advantages over the chloride and bromide of manganese, which are both not only

very hygroscopic, but if fused in hydrochloric acid gas (hydrobromic acid in the case of the bromide) are liable to retain traces of the gas, and this would consequently make the atomic weight too low. All researches on the oxides of manganese have shown that similarity; they are all difficult to obtain in anything like a definite form, with perhaps the exception of the protoxide.

Table II. gives the results of the titration done by the method above described. The use of sulphurous acid as the reducing agent was found unsatisfactory, as a slight residue having the appearance of sulphide was almost always left undissolved. The production of sulphate was also more or less troublesome from its insolubility.

Experiments (6) and (7) were made with a sample obtained indirectly from the barium salt, and were slightly higher owing to the presence of a small trace of barium sulphate easily recognisable by the slight turbidity of the reduced solution. We had hoped by the use of a larger quantity of material than was generally employed, and by the more accurate modes of analysis, to arrive at results comparable in some degree at least with those of Stas; but the preparation of considerable quantities of material of absolute purity frequently involves sources of error not incurred in the preparation of smaller quantities. This we found especially the case in the preparation of our pure potassium bromide, which contained traces of sulphates in every sample. This sulphate is due to the use of ordinary gas in the ignition of the pure bitartrate of potash from which the bromide of potassium was made. In order to get a pure product gas must be replaced by a powerful flame of alcohol, or all the operations conducted in a muffle.

The mean atomic weight of manganese which results from the average of the last [eight determinations is 55.038, oxygen being taken as 16 and silver as Stas's value 107.93.

Thus another element is added to the list of those whose atomic weights have been found on revision to be exceedingly near whole numbers.

Further details and discussion must be reserved for another communication.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING JANUARY 31ST, 1883.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To the RIGHT HONOURABLE THE PRESIDENT OF THE
LOCAL GOVERNMENT BOARD.

February 6th, 1883.

SIR,—We submit herewith the results of our analyses of the 189 samples of water collected by us during the month of January, on the days and at the times indicated, from the mains of the seven London water companies taking their supply from the Thames and the Lea.

Of these 189 samples, all, excepting five which were recorded as "very slightly turbid," were found to be bright, clear, and efficiently filtered.

In Table I. we have recorded the analyses in detail of a daily sample, taken from January 1st to January 31st inclusive. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

We have recorded in Table II. the tint of the several

samples of water as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples collected.

The condition of the water during the past month, in respect both to its general freedom from colour and turbidity and to its state of aëration, has continued, notwithstanding the renewal of the river floods, to be eminently satisfactory; while there has not been any appreciable increase in the proportion of its dissolved organic matter. Thus the maximum quantity of organic carbon found in any sample of the water was 0.320 part in 100,000 parts, the average of all the samples examined during the month being 0.217 part, as against an average of 0.210 part in the previous month. The maximum of 0.320 part of organic carbon in 100,000 parts of water corresponds to a little over half-a-grain of organic matter per gallon; and even this amount was present in one exceptional sample only out of the 189 samples reported on.

We have the honour to remain, Sir,

Your obedient Servants,

WILLIAM CROOKES,

WILLIAM ODLING,

C. MEYMOTT TIDY.

SEPARATION OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

(Continued from p. 17.)

Separation from Rhodium.—This may be effected by the four following methods:—

1. In a strongly acid hydrochloric solution the gallium is precipitated by potassium ferrocyanide either in the cold or at a moderate heat. All the rhodium remains in solution. To remove it the liquid is mixed with sulphuric acid and sodium bisulphide and evaporated to dryness, raising the temperature finally to redness. Rhodium and iron are then separated by known methods.

2. The action of sulphuretted hydrogen upon rhodium chloride is very slow in the cold and not rapid even at 85°–90° in dilute solutions. At 100° the rhodium chloride is quickly converted into sulphide. The solution should be distinctly acid. If a high degree of exactitude is required the mother-liquors must be concentrated as far as possible without drying them up, expelling the greater part of the hydrochloric acid and repeating the treatment with sulphuretted hydrogen at a boiling heat. In this manner only insignificant traces of the rhodium are lost.

The rhodium sulphide, after filtration and washing with water slightly acidulated with hydrochloric acid, still retains traces of gallium. To remove these it is re-dissolved in aqua regia, the nitric acid being afterwards expelled and re-precipitated by sulphuretted hydrogen at a boil. Along with the sulphide there is deposited sometimes a little metallic rhodium which is not attacked by aqua regia. With care this process gives good results.

3. Copper reduces rhodium, slowly in the cold, but more rapidly at 90°.

It is well to operate upon hydrochloric solutions, slightly acid, and of the smallest volume possible. The water is replaced as it evaporates, and at intervals traces of hydrochloric acid are added. Several hours of heating are necessary. The rhodium thrown down by the copper does not retain gallium, and is partially soluble in aqua regia.

4. In a distinctly acid hydrochloric solution the rhodium is reduced by zinc on prolonged contact at 90°. A brisk evolution of hydrogen must be kept up by successive additions of zinc and HCl. The reduced metal retains a little gallium, but in a much less proportion than in the cases of palladium or platinum.

Remarks on Certain Reactions of the Salts of Rhodium.

—Chemical treatises give, for the qualitative analysis of the salts of rhodium, certain instructions which are incomplete, and to persons not familiar with the rarer metals may prove misleading. Such are:—

"*Ammonium Sulphide*.—A brown precipitate of sulphide which forms slowly, and is insoluble in excess."

"*Sulphuretted Hydrogen*.—A brown partial precipitate, which is formed slowly, and dissolves in hydrochloric acid."

On these instructions I remark that an excess of ammonium hydrosulphate easily re-dissolves the rhodium sulphide, especially at about 40° or 50°; the solution is of an orange-red. If rhodium sulphide is ultimately entirely deposited in presence of the hydrosulphate, it is only after the lapse of a very long time, and from an analytical point of view we may consider this compound as soluble in an excess of ammonium hydrosulphate.

An ammonium hydrosulphate solution of rhodium, after having been left for a fortnight in an imperfectly closed vessel, at temperatures varying from 15° to 70°, was filtered and enclosed in flasks sealed at the lamp. Twenty days later there was found deposited on the sides of the vessel only a quantity of sulphide, relatively very trifling compared with that remaining in solution. The thin pellicle of sulphide attached to the glass was not sensibly soluble in ammonium hydrosulphate.

Rhodium sulphide formed by sulphuretted hydrogen at a boil is likewise insoluble in the hydrosulphate, contrary to what is observed by the sulphide deposited by a boiling ammonium sulphide solution. This latter compound is easily re-dissolved in the hydrosulphate.

The solubility of its sulphide in an excess of ammonium hydrosulphate may serve to separate rhodium from such metals as copper, iron, and zinc, whose sulphides are very slightly dissolved by the hydrosulphate.

If an ammonium hydrosulphate solution of rhodium is treated with a small excess of hydrochloric acid we obtain a reddish-brown sulphide, which dissolves, it is true, in part in strong hydrochloric acid, and even in acetic acid. But in presence of sulphuretted hydrogen there is again formed rhodium sulphide of a much deeper brown, almost black, of which hydrochloric acid dissolves mere traces.

There exist, then, two rhodium sulphides, analytically distinct. The one is of a chocolate-brown, slightly reddish, very soluble in ammonium hydrosulphate, and partially soluble in hydrochloric acid. The other of a blackish-brown, is insoluble in both these reagents.—*Comptes Rendus*, xcvi., p. 152.

SEPARATION OF MAGNESIA FROM LIME,
FERRIC OXIDE, AND THE ALKALIES.

By H. HAGER.

If 1 grm. magnesia is treated with 80 c.c. of a cold 5 per cent solution of oxalic acid a clear solution is obtained, which on boiling deposits all its magnesia as magnesium oxalate. A very small portion of the precipitate is re-dissolved on cooling. If the magnesia is mixed with 10 parts of glycerin before solution in oxalic acid no turbidity occurs on standing in the cold, but the magnesium oxalate is nevertheless precipitated on boiling. For separating calcium from magnesium when both occur as carbonates, the author mixes the finely-powdered sample with 10 parts of glycerin and a little water, and adds 40 to 50 parts of solution of oxalic acid at 5 per cent. Calcium and magnesium oxalates are both formed, the former remaining undissolved, whilst the magnesium salt passes into solution. After standing for half an hour the calcium oxalate is collected upon a filter, washed, and determined as usual. The filtrate is boiled in a flask for five to eight minutes, filtered boiling, and the precipitate is dried and weighed as magnesia.

In a solution containing salts of calcium and magnesium the liquid is first mixed with glycerin, a sufficiency of ammonium oxalate is added, the liquid is strongly acidulated with oxalic acid, and the process completed as above.

Magnesium can also be precipitated as an oxalate in presence of ferric oxide by adding glycerin, ammonium oxalate, and oxalic acid, and boiling. In order to determine the ferric oxide in the filtrate it is heated to a boil along with ammonium carbonate, evaporated to dryness, the glycerin extracted with alcohol, the insoluble residue is treated with hot ammoniacal water, and the ferric hydroxide is collected upon a filter.

For separating magnesia from the alkalies, the hydrochloric solution is boiled with ammonium oxalate and oxalic acid, and filtered at a boil.

The author gives the following method for ascertaining whether in calcined magnesia or in the carbonate the proportion of lime exceeds a certain limit:—0.1 grm. of the calcined magnesia, or 0.25 grm. of the carbonate, must be well shaken up in a test-tube with a solution of oxalic acid at 5 or 10 per cent. Perfectly pure preparations dissolve in the first minute, and the solution remains clear for five minutes: in presence of lime the solution is turbid. In the latter case the agitated turbid liquid is poured into a test-tube of 1.25 c.m. in width, and an inkline upon paper 1 m.m. in breadth is examined through the column of liquid. If this is still possible the proportion of lime in the calcined magnesia does not exceed 0.25 per cent, and that in the carbonate 0.1 per cent.—*Zeitschrift für Analytische Chemie*.

NEW METHOD FOR
SEPARATING VANADIC ACID FROM METALS.

By W. HALBERSTADT.

THE method of separating vanadic acid from barium, calcium, zinc, and lead, is based—like Classen's method of separating phosphoric and arsenic acid from metals—upon the circumstance that on heating with ammonium oxalate and acetic acid the metals are precipitated as oxalates, whilst the vanadium remains in solution. The hydrochloric solution is evaporated to dryness in the water-bath, and the residue digested with a saturated solution of ammonium oxalate with the addition of a few drops of strong acetic acid till everything is dissolved. The liquid is poured into a beaker, heated upon a wire gauze, and acetic acid is slowly dropped in from a burette, stirring all the time, as long as a deposit of oxalate is formed. It is digested for some hours at a moderate heat upon the sand-bath, filtered, washed with a mixture of equal volumes of strong acetic acid, water, and alcohol, the filtrate is evaporated to dryness on the water-bath in a tared platinum capsule, the volatile ammoniacal salts driven off by cautious heating, the residual vanadium oxide oxidised to vanadic acid by fusion in a current of oxygen, and weighed.

This method is found successful for separating vanadium from barium, calcium, zinc, and lead, but it is not suitable for a quantitative separation of vanadium from cobalt, nickel, manganese, magnesium, bismuth, copper, and cadmium.

Classen and Von Reis utilise the behaviour of the metallic double oxalates with acetic acid for the separation of arsenic and phosphoric acid from metals.

The great resemblance between vanadic acid and the two acids just named rendered a comparison of their behaviour with oxalic acid and the oxalates desirable.

Vanadic acid when boiled with oxalic acid is reduced to oxide, and takes a blue colour; in potassium, sodium, and ammonium oxalate it dissolves in considerable quantity with a yellow colour, which passes into a blue on the addition of strong acetic acid.

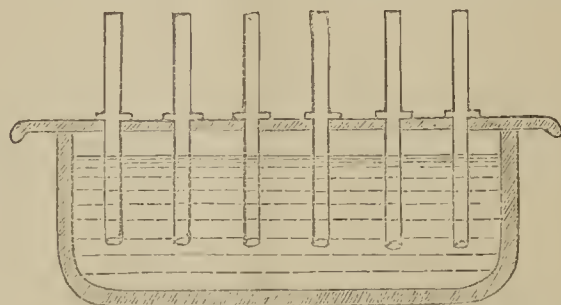
The saturated solution in potassium oxalate, if placed in the desiccator over sulphuric acid, deposits yellowish adherent crystals, which readily dissolve in water, and on exposure to air take a greenish brown colour. On adding alcohol and boiling with potassium oxalate and acetic acid all the vanadium is separated. Phosphoric and arsenic acid, on the contrary, if similarly treated remain in solution in combination with potassium. According to the proportion of the acetic acid and alcohol there is obtained a green or dark-blue deposit of vanadium oxide along with the excess of potassium oxalate. With sodium oxalate the separation of vanadium by alcohol is less complete, and still less so with the ammonium salt. Alkaline meta- and ortho-vanadates behave with oxalic acid as does vanadic acid.

The vanadium oxide obtained with oxalic acid or ammonium oxalate and concentrated acetic acid, passes again into vanadic acid on evaporation to dryness, expulsion of the ammoniacal salts, and subsequent ignition in a current of oxygen, as the author has proved by direct experiment.—*Zeitschrift für Analytische Chemie*.

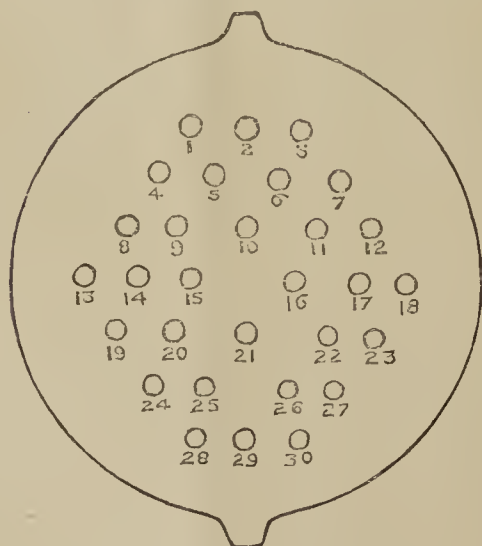
APPARATUS FOR BOILING GOLD ASSAYS.

By W. F. LOWE.

THE apparatus consists of (1) a porcelain basin (a) $8\frac{1}{2}$ ins. in diameter, having a capacity of 50 ozs.; (2) a porcelain cover (b) perforated with thirty holes, each hole being numbered in black enamel; and (3) of a number of glass tubes (c). These tubes are made to slip loosely through the holes in the cover, and in order that they may not come against the bottom of the basin the glass is bulged



Section of basin, tubes, and cover, one-fourth size.



(b) Cover, one-fourth size.

out into a ring, near the centre of the tube, which rests upon the cover: they have two small holes, one on each side of the bottom, one in the centre of the bottom, and also one in the side an inch above.

The method of employing the apparatus is the following:—Two basins, containing a sufficient quantity respectively of strong and weak nitric acid, are heated over the lamp, the weak acid basin being covered with the perforated cover carrying the boiling tubes, and the strong acid being covered with an ordinary dinner-plate. The assays, which can be flattened and rolled while the acid is being heated, are dipped into the tubes; and in about five minutes, if the acid is boiling, the whole thirty may be lifted off by the cover, washed by being dipped into a basin of water, and then transferred to the basin of strong acid, where they are boiled for half an hour or more, after which they are all lifted off by the cover, and transferred



(c) Tube, half size.

to a similar basin full of water. Each tube is taken out, and plunged over head in water so as to fill the tube, and the assay is transferred to the crucible in the same way as from a flask.

I have had this apparatus at work for more than twelve months, and have found it a great saving of labour, besides requiring so little attention; in fact, it can be left for an hour without the assays taking any harm, and I consider it preferable to boiling in flasks, for all the assays are under exactly the same conditions, and can be boiled in the acid for a much longer time. Another recommendation is that it is of very moderate cost. For boiling the basins I use two of Fletcher's radial burners, which are very suitable, as they are little affected by the fumes.

OFFICIAL REPORT OF THE COMMITTEE OF THE INTERNATIONAL SMOKE ABATEMENT EXHIBITION, 1882.*

THIS interesting report was printed and presented to the Duke of Westminster, as President of the Smoke Abatement Exhibition, in June last, but its publication has from various causes been delayed until now.

In the year 1306 the combustion of bituminous coal in London was prohibited by the King at the petition of Parliament; but the smoke of this fuel still remains so unsubdued a nuisance that after a lapse of exactly five-and-three-quarters centuries the International Smoke Abatement Exhibition was held at South Kensington. By far the larger number of appliances there exhibited consisted of grates and stoves, and their inventors had sought to perfect combustion in them by one of the following methods:—

- (1.) The supply of air to the fire was largely increased.
- (2.) The fresh fuel was charged in below that already burning.
- (3.) The fuel was charged into hoppers situated either

London: Smith, Elder, and Co., 1883.

at the back or sides of the grate, where it became partially coked, the products of distillation entering the fire at some point below its surface, and the partially-coked fuel was afterwards charged in either at the back of or below the fuel already in a state of combustion.

(4.) The fresh fuel was placed on the top of that already burning, and the products of combustion, distillation, &c., were made to pass, more or less completely, through the fire, issuing from it at some point below its surface.

(5.) The products of distillation and combustion, &c., were brought into contact with air more or less highly heated.

The grates relied on one or other of the above systems, but in the case of stoves, only the first and the last two systems were adopted. Some of the grates and stoves were constructed so as to admit of only a limited supply of air to the fire in order to cause the fuel to be more slowly consumed.

It will be seen that the methods adopted with a view to ensure complete combustion were very varied, but in this notice we propose to consider briefly the chemical tests to which the effluent gases from stoves and grates were submitted.

In a report on the gases escaping from the flues to which these stoves and grates were attached, Professor W. Chandler Roberts, of the Royal School of Mines, states that, taking into consideration the circumstances under which the tests had to be conducted, he was led to adopt the following method:—

A hole was bored through the wall of the room to the flue, and through the hole was inserted a copper tube provided with a narrow slit equal in length to the diameter of the flue, across which it was placed; an arrangement was also provided by means of which it was possible to prevent the slit becoming choked. This tube was inserted into the flue at a point 10 feet from the floor; this height being chosen in order to ensure that the samples of gas taken should be of the same average composition as that of the gaseous mixture which passed out of the flue into the atmosphere.

Hung up on the wall, as close as possible to this tube, and in connection with it, were a series of tubes, the first of which was partially filled with asbestos; the second was a U-tube filled with chloride of calcium; then followed three U-tubes filled with soda-lime, each one having a plug of chloride of calcium at the end furthest from the flue to prevent any escape of moisture. The last of these tubes was connected by means of glass tubing with a porcelain one containing cupric oxide, and heated to redness in a combustion-furnace. On the other side of the tube came first a U-tube filled with chloride of calcium; next came two U-tubes filled with soda-lime and chloride of calcium as before: and, lastly, between these tubes and the water aspirator was placed another tube of chloride of calcium.

Directly the fire was lighted aspiration was commenced and continued for a period of three hours, during which time as nearly as possible half a cubic foot of water was run out. The gases on their way to the aspirator were first filtered by the asbestos, which retained all the solid matter, some moisture, and small quantities of gaseous hydrocarbons, &c., enclosed in the sooty matter. The remainder of the water was next absorbed by the chloride of calcium, and the carbonic anhydride by the soda-lime, the free hydrogen, hydrocarbons, and carbonic oxide were burnt by the cupric oxide, the water and carbonic anhydride so formed being absorbed by the calcium chloride and soda-lime respectively. The residual oxygen and nitrogen passed away to the aspirator, but as the ratio in which they stood to one another depended so greatly on the dilution of that air which had passed through the fire, by air which had simply passed up the chimney without passing through the glowing coal, no separate analysis was made of them.

At the termination of the test the tubes were disconnected, and the one containing the asbestos was heated to a temperature of about 200°C ., the connection with the

tube containing ignited cupric oxide and the tubes beyond being maintained. The first chloride of calcium tube was placed between the asbestos tube and the one containing the cupric oxide, and a current of air free from moisture and carbonic anhydride being aspirated through, the water and some of the solid hydrocarbons were driven forward and retained by the calcium chloride tube, and the gaseous hydrocarbons were burnt by the cupric oxide. It was not possible to heat the asbestos sufficiently to distil off all the solid hydrocarbons, &c., as the point would soon have been reached at which the combustion of the free carbon particles commenced.

By this means the ratio was obtained in which the various gases contained in the sample taken from the flue stood to one another, and in order to make the results obtained from the different grates and stoves comparable, the carbon present as carbonic anhydride was in each case raised to 1000, and the carbon as carburetted hydrogen and carbonic oxide, taken together, were proportionately increased and referred to the 1000 parts of carbon burnt to CO_2 . It was found that the carbon as carbonic anhydride stood to that as carburetted hydrogen and carbonic oxide in ratios which varied between the limits of 1000:4 and 1000:375; but of the whole 86 tests in only three was it above 1000:10, and in only nine cases did the ratio rise below 1000:200, and of these no less than 6 were purposely worked with a limited (or reduced) supply of air.

In connection with this it may be interesting to point out that the limits 1000:10 and 1000:211 were those in which M. Scheurer-Kestner (in his celebrated research on the combustion of fuel in boiler-furnaces) found the C as CO_2 to bear to the C as CO and C_xH_y , and these limits do not differ much from those found by Prof. Roberts.

The increase in weight of the asbestos tube did not permit of any direct generalisation being made as to the amount of carbon lost as soot, but the flues were in many instances swept after the test, and the soot so collected was weighed. It was found to vary between the limits of $\frac{1}{2}$ and $2\frac{1}{2}$ per cent of the total carbon in the fuel, and two tests made by Prof. Roberts especially to determine the amount of soot so deposited showed it to be in the first case 0.6 per cent, and in the second 0.75 per cent. In the first instance 17 lbs. of coal were burnt in three hours in an open grate, and the soot deposited in a sheet-iron tube 6 feet long and 9 ins. in diameter, was collected and weighed; in the second, 10 cwts. of coal and 59 lbs. of wood were burnt, and the soot, which had been deposited in a flue 60 feet high, was weighed, and gave the above-mentioned result. This would seem to confirm the view frequently expressed recently that the amount of carbon lost as soot does not exceed 1 per cent.

The total carbon in the samples taken stood to the total hydrogen, in a free state and combined with carbon, in ratios varying between the limits of 1000:8 and 1000:259, which, while higher than those obtained in boiler-furnaces by Scheurer-Kestner, yet agree with some analyses of the gases escaping from locomotives made by M. Foucou; and it is to these latter that the tests on grates made at the Exhibition bear the greatest similarity, as they were always tested directly after having been placed in position, and consequently surrounded by wet mortar, which became almost dry during the test. In order to determine the relation which the carbon present as carbonic oxide stood to that existing in the form of gaseous hydrocarbons, a sample of gas was taken from the flue to which a grate was attached that was purposely stoked very badly; this was collected in a mercurial receiver, and showed on analysis that while very little carbonic oxide was present, yet the carbon as carbonic anhydride bore to that as marsh-gas a ratio (by weight) of 1000:529.

The mean of the results from the seventeen best tests of grates shows a loss of carbon as gas of about $3\frac{1}{2}$ per cent of the total carbon in the fuel, both for Wallsend and anthracite, but the mean for the whole of the grates shows a loss of nearly 9 per cent.

The best of the close stoves showed a loss of carbon in gaseous compounds of about $2\frac{1}{2}$ per cent of the total carbon in the fuel, the mean for the whole class being $6\frac{3}{4}$ per cent.

Slow and rapid combustion in the same stove, and under similar conditions, showed that of the total carbon in the fuel 11.9 per cent and 1.9 per cent were lost respectively as gaseous compounds.

The combustion in the stoves was found to be about as complete as that in the best class of open grates, which class was decidedly, as far as completeness of combustion went, the one in which the products of distillation, combustion, &c., were made to pass down through the fire, the next best class to this being the one which relied on the admission of larger quantities of air to the fire.

Under-feeding did not seem to be particularly effective in the majority of the grates, but it certainly was in the one exhibited by Messrs. Brown and Green which took the Gold Medal.

The worst class of all was that in which a limited supply of air was admitted to the fire in contradistinction to the one admitting larger quantities, which, as was before stated, was the second best.

The stove exhibited by Mr. C. B. Gregory, of Beverley, New Jersey, which was awarded the highest medal for its class, consisted of a gas-generator with hollow fire-brick sides through which air passed, became heated and met the column of gas on all sides as it passed through a narrow slit. It gave one broad sheet of flame and no smoke. Several applications of this stove—or rather furnace—were shown at Manchester.

The methods by which it was sought to perfect the combustion of fuel in boiler furnaces consisted (1) in charging in the coal at the front of the fire at regular intervals, either directly or on to the bars, or first on to a dead-plate, and in this manner compelling the products of distillation, &c., to pass over the whole of the clear fire beyond. The fuel so charged in was gradually drawn back by the motion of the fire-bars, which either moved in sections or one after the other. (2) In scattering the fuel in small quantities over the whole surface of the grate. (3) By allowing air to enter through the fire-door, a perforated dead-plate, or hollow fire-bridge, &c.

Other methods consisted in forcing in air above the fuel by means of a steam-jet; in increasing the air-supply by using a kind of basket-grate; by causing a better admixture of air with the products of combustion by means of diaphragms, &c.

Almost all of these seemed to conduce either in a greater or a lesser degree to the combustion of the smoke.

In the comparative tests of Welsh steam coal and anthracite, with regard to their respective evaporative powers, which were made by Mr. D. Kinnear Clark, M.I.C.E., it was found that the steam coals as a class evaporated per pound of fuel 10.95 lbs. of water from and at 100° C.: the anthracites evaporated but 10.05 lbs., so that the steam coals gave results which were 0.9 per cent better. The best anthracite exhibited possessed about the same evaporative power as the best steam coal, viz., rather under 14.3 lbs. of water per lb. of fuel; but it took far longer to get up steam with the anthracites than it did with steam coal, and the clinker from the former was far more difficult to remove, and the fire-bars were much more attacked, when it was used than when the anthracite type of coal was burnt.

Although the results of the Smoke Abatement Exhibition show that the success yet attained is only partial, still they afford a foundation to build upon, and it would consequently seem as though there could be no doubt but that more vigorous action in the future will be crowned with complete success. It is certain that chemical information of much interest has been gained, and the Report bears abundant evidence of the pains Professor Roberts took to bring the work to a successful issue.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, February 24th, 1883.

Prof. CLIFTON, President, in the Chair.

New Members:—Prof. A. W. Scott, M.A., Mr. F. G. M. Page, B.Sc.

Mr. LEWIS WRIGHT read a paper on the "*Optical Combinations of Crystalline Films*," and illustrated it by experiments. He exhibited the beautiful effects of polarisation of light, and the Newtonian retardation by means of plates built up of thin mica films and Canada balsam. The wedges thus formed gave effects superior to those of the more expensive selenite and calcite crystals. The original use of such plates is due to Mr. Fox, but Mr. Wright showed many interesting varieties of them, including what he termed his "optical chromotrope," formed by superposing a concave and $\frac{1}{4}$ -wave plate on each other. Norenberg's combined mica and selenite plates were also shown.

Mr. SPOTTISWOODE praised the results very highly, and pointed out their value to the teacher and student, as showing how the effects can be produced step by step. The phenomena can be shown by an addition to the ordinary microscope, costing some 2 guineas, as made by Messrs. Swift and Sons.

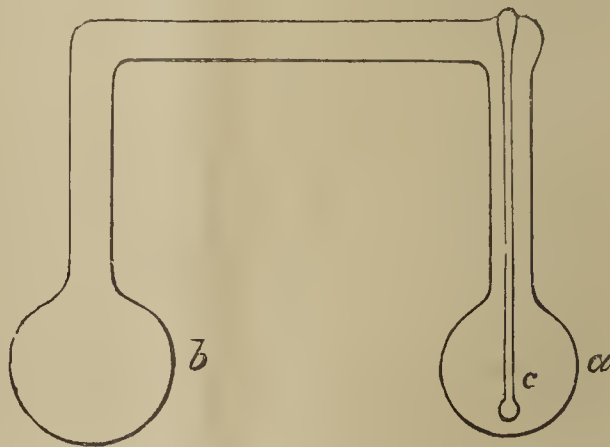
Mr. BRAHAM then gave an experimental demonstration of the vortice theory of the formation of the solar system by rotating a drop of castor oil and chloroform in water until it threw off other drops as planets.

CORRESPONDENCE.

ICE UNDER LOW PRESSURES.

To the Editor of the Chemical News.

SIR,—The exhibition of the infusibility of ice under low pressures has up to the present time been a somewhat troublesome matter, the amount of time spent in getting the apparatus in order being generally very great. The following method of showing the experiment is simple and works very well, and the apparatus once prepared is



always ready for use. The instrument is an ordinary Wollaston's cryophorus with a glass tube or rod fused into one angle of the glass tube, and terminating in a knob (c) rather below the centre of the bulb. The apparatus is exhausted by boiling water in both bulbs until the right amount is left, and then sealing up.

The water is allowed to flow into the bulb (a) in which

the rod is fixed, and the other bulb is placed in a freezing-mixture. When the water in (a) is frozen to a sufficient depth it is placed for a few moments in warm water, so as to melt the ice in contact with the glass. The water formed is poured quickly into the bulb (b), which is at once replaced in the freezing-mixture. By carefully heating the bulb (a) the whole of the ice in contact with the bulb may be melted and removed, leaving a free block of ice attached to the knob. The bulb may then be placed in a beaker of boiling water, sulphuric acid, or oil, and so long as (b) remains in the freezing-mixture the ice will not melt.

At a meeting of the Owens College Chemical Society, when the apparatus was exhibited, the bulb (a) remained in boiling water for about an hour and a half, when the sublimation had proceeded so far that the ice became detached from the knob and fell, and then immediately melted. This is explained by the fact that when the ice comes in actual contact with the hot glass the vapour formed is not removed with sufficient rapidity to keep the pressure below what may be called the critical pressure, and thus the ice melts at once.

By placing thermometers in each bulb the relative temperatures of the ice and of the condenser may be readily ascertained, and Prof. Ramsay and I hope shortly to make some experiments to settle this point; while by a modification of the apparatus, devised by Prof. Ramsay, the latent heat of sublimation of ice may, we hope, be determined.—I am, &c.,

SYDNEY YOUNG.

University College, Bristol,
February 23, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 3, January 15, 1883.

Researches on the Alkaline Sulphites.—M. Berthelot.—The anhydrous potassium bisulphite of Muspratt, Rammelsberg, and Marignac, instead of belonging to the same type as the other sulphites, constitutes a peculiar type, representing a new saline series, the meta-sulphites.

Alkaline Hyposulphites.—M. Berthelot.—The author determines the decomposition-temperatures of the alkaline hyposulphites.

Separation of Gallium.—Lecoq de Boisbaudran.—See page 100.

Hydraulic Silica, and the Part which it plays in the "Setting" of Hydraulic Compounds.—E. Landrin.—Hydraulic silica is the cause of the final hardening of hydraulic mortars. Calcium aluminate, like gypsum, determines in certain cases the setting of the mortar, but it cannot take part in the final hardening of hydraulic materials on account of its solubility. Still, as this solubility is not instantaneous, calcium aluminate, at the moment of immersion, promotes the ultimate union of the hydraulic ingredients, and prevents the water from penetrating into the mass of the mortar, thus facilitating the slow and reciprocal action of the lime and the hydraulic silica.

Chemical Studies on Maize at Different Stages of its Vegetation.—M. H. Leplay.—The author discusses the accumulation of the principal mineral constituents of the soil in different parts of the plants.

Methods for the Determination of the Ohm.—M. Brillouin.—A general exposition of the principles upon which such methods are based.

Reply to a Paper by M. Maurice Lévy.—M. Deprez.—A discussion of the law that the electromotive power evolved by the ring of an induction machine, the intensity of the current being supposed constant, is proportional to the speed of the ring.

Researches on the relative Oxidisability of Cast-iron, Steel, and Wrought-iron.—M. Gruner.—Soft steel is less attacked by acidulated waters, sea-water, &c., than any other of these materials. The action upon tempered steel is ten times greater. Chrome-steel is more energetically attacked than pure steel, but tungsten-steel less so.

Losses and Gains of Arable Soils in Nitrogen.—P. P. Dehérain.—The losses of nitrogen in arable soils are due, not merely to the requirements of the crops, but to a greater extent to the oxidation of the nitrogenous organic matter, these losses being the more considerable the more the soil is turned over. When the land is undisturbed, and kept in natural or artificial meadows, the air penetrates less easily; the combustion is less active, and the gain of nitrogen exceeds the losses. Hence a farmer can enrich his fields with nitrogen more readily by keeping them in pasture than by lavishing manure upon them.

No. 4, January 22, 1883.

Metasulphites.—M. Berthelot.—The author describes potassium metasulphite, the transformation of the dissolved bisulphite into metasulphite, the formation-heat of the latter, its hydrates, their solution-heat, and the pyrogenous decomposition of the metasulphite.

Nitrogen Selenide.—MM. Berthelot and Vieille.—The authors have determined the heat liberated by the explosion of this substance.

Characters of the Induced Currents resulting from the Reciprocal Movements of two Magnetic Bodies Parallel to their Axis.—Th. Du Moncel.—This paper does not admit of useful abridgment.

Theory of the most general Electro-dynamic Actions which may be observed.—P. Le Cordier.—The author's object is to establish the formulæ discovered by Ampère, representing the most general electro-dynamic action which may be observed in a linear element of a fixed current, of constant intensity, and not forming part of the acting system.

Communication by MM. Mercadier and Vaschy relating to the consequences which may be deduced from the relations between Electric Magnitudes.—M. Maurice Lévy.—This memoir does not admit of abstraction.

Remarks on the Expression of Electric Magnitudes in the Electro-static and Electro-magnetic Systems, and on the Relations thence deduced.—MM. Mercadier and Vaschy.—The coefficient k' of the formulæ of electro-dynamics is an absolute constant; it is the same with the coefficients of the formulæ of magnetism and electro-magnetism: k' being an absolute constant, the coefficient k of Coulomb's law is the square of a velocity.

Hydraulic Silica.—H. Le Chatelier.—The writer maintains that the results announced by M. Landrin have long been public property, with the exception of the non-hydraulicity of the silica derived from the preparation of hydro-fluosilicic acid.

Mutual Displacements of Bases in Neutral Salts, the Systems remaining Homogeneous.—N. Menschutkin.—This paper will as soon as possible be inserted at length.

Causes capable of affecting the Proportion of Ammonia in Rain-water.—A. Houzeau.—The author has recently received specimens of rain-water from Algeria, in which it was impossible to detect the smallest trace of ammonia. In a former memoir (*Comptes Rendus*, September, 1876) he has shown with what rapidity waters

lose ammonia under the action of solar light. Heat has the same effect as light. Ammonia is also absorbed by the organic matter in water. The greater the quantity of rain which falls the smaller is its proportion of ammonia.

Action of Certain Metals upon Oils.—A. Livache.—The author has studied the action of lead, copper, and tin in a state of fine division upon oils. Lead acts most energetically, effecting a greater increase of weight, in case of the drying oils, in two days than occurs on simple exposure to the air for eight months. Upon the non-drying oils the effect of lead in two days was not appreciable. The action of precipitated lead upon oils may serve as a method of detecting mixtures of the drying and of the non-drying oils. In place of boiling oils, such as linseed—a process which is always attended with an offensive odour and a risk of fire—they may simply be allowed to flow in the cold over plates of zinc or iron upon which metallic lead has been precipitated.

Zeitschrift für Analytische Chemie.
Vol. xxi., Part 4, 1882.

Method for the Volumetric Determination of Phosphoric Acid, either Free or Combined with Bases.—O. Schlickum.—Schlickum's method requires either free phosphoric acid or an acid phosphate. Neutral or basic phosphates are made acid by solution in hydrochloric or nitric acid, the liquid is mixed with tincture of cochineal, and normal alkali is added until the colour of the solution changes from yellow to a violet-red. For the titration of the phosphoric acid or of acid phosphates, Schlickum adds a sufficiency of magnesium sulphate and tincture of litmus, and then normal ammonia drop by drop, till the liquid appears permanently blue. The end of the reaction is reached when a drop of ammonia produces no further change. If an excess of ammonia has been added the precipitate is filtered off, and the filtrate titrated back with normal acid. The quantity of phosphoric acid is calculated from the ammonia consumed. If only free phosphoric acid was present the third part of the c.c. of normal ammonia consumed is multiplied by 0.071. In case of an acid phosphate half the c.c. of normal ammonia consumed are multiplied by 0.071. If lime is present it must be removed or rendered incapable of reaction before addition of the magnesium sulphate. Schlickum effects this by boiling the liquid containing acid calcium phosphate with sodium sulphate, and allowing the calcium sulphate formed half an hour to settle.

Titration of Free Phosphoric Acid.—A. Joly.—From the *Comptes Rendus*.

Chemical Analysis of Organic Bodies.—(1. Qualitative Detection of Organic Bodies.)

The Spectra of Carbon and its Compounds.

Papers by Wesendonck, Liveing, Watts, &c., are mentioned, but not summarised.

Applications of Spectral Analysis in the Examination of Organic Bodies.—B. Nickels, W. N. Hartley, and A. K. Huntington.—From the *CHEMICAL NEWS*.

New Reaction for Kreatin and Kreatinin.—J. Weyl.—A very dilute aqueous solution of kreatinin, if mixed with a very dilute solution of sodium nitro-prusside, and then with sodium chloride, drop by drop, takes a fine ruby-red colour, which passes into a straw-yellow. As kreatin is easily converted into kreatinin it may likewise be detected by this reaction. According to E. Salkowski if the straw-yellow liquid is acidulated with acetic acid, it assumes, first a green, and then a permanent blue.

Characteristic Reaction of the Sulph-hydrates.—Peter Claesson.—These compounds are all coloured by the addition of ammonia and a few drops of very dilute ferric chloride. The sulph-hydrates of methyl, ethyl, amyl, benzol, toluol, and the thiocetic acid, turn to a dark reddish brown; thioglycolic and thiolactic acids, to a dark

violet-red; the sulphocyanides and the hyposulphites deep red; and the hydrosulphates of the alkaline and earthy metals, green.

Detection of Alcohol.—K. Tumsky.—The blue colour produced when alcohol acts upon a solution of molybdic acid in sulphuric acid has been proposed as a test. The author shows that even a moderate quantity of water prevents the reaction.

Reaction of Oil of Peppermint.—C. Roucher.—From the *Druggists' Circular*.

Reactions of Thymol.—MM. Hammarsten and Rolbert.—From *New Remedies*.

Conversion of Starch into Sugar.—F. Musculus and A. Meyer.—The bodies which the authors have formerly described as achroo-dextrine and erythro-dextrine are mere mixtures.

Transformation of Glucose into Dextrine.—F. Musculus and A. Meyer.—When glucose is mixed with sulphuric acid and then with absolute alcohol, a white precipitate is formed on standing, which may be regarded as a dextrine containing 1 mol. alcohol in place of 1 mol. water.

Behaviour of Starch with Glycerin.—Karl Zulkowsky.—Starch dissolves if heated in glycerin, and passes into the modification soluble in water.

Xanthogenic Acid as Precipitant for Alkaloids.—Ph. Zöller.—The alkaloids in all cases when they exist in acid solution or remain in solution when acidulated with very dilute acids, are thrown down as a flocky precipitate on the addition of a few drops of potassium xanthogenate.

The Nitro-prussides of the Alkaloids.—E. Davy.—From the *Pharmaceutical Journal*.

The Alkaloids of Jaborandi Leaves.—E. Harnack and H. Meyer.—From *Liebig's Annalen*.

Piturine.—H. Liversidge.—From the *CHEMICAL NEWS*.

Coloured Reactions of Morpheine, Codeine, and Atropine.—D. Vitali.—If morphine is dissolved in sulphuric acid (undiluted), sodium arseniate added, and heat applied, there appears a blue-violet colour, which turns pale green, and on the addition of water turns first to a rose, and then to a blue, which on the addition of an excess of ammonia becomes green. Morphine, dissolved in sulphuric acid, mixed with sodium sulphide solution, and heated, gives a flesh colour, which turns to a violet, and then to a dark green. If, after the sodium sulphide, a solution of potassium chlorate in sulphuric acid is added, the colour is first green, then violet, and is turned yellow by excess of chlorate. Codeine gives quite similar reactions. If a solution of potassium chlorate is dropped upon atropine, blue-green streaks appear on moving the capsule. If more of the solution is added, a clear light green liquid is formed.

Picrotoxine.—L. v. Barth and M. Kretschy maintained some time ago that picrotoxine is a mixture of two new bodies, which they named picrotoxine and picrotine. In opposition to this view Paterno and Ogliaro, also E. Schmidt and E. Löwenhardt, maintain the unitary character of the old picrotoxine, and pronounce the bodies discovered by Barth and Kretschy to be products of decomposition.

Cinchonidin^o, Homo-Cinchonidine and Cinchonine.—H. Skraup has formerly maintained the identity of cinchonidine and homo-cinchonidine. Hesse (*Liebig's Annalen*) upholds their distinct character.

Quantitative Determination of Organic Bodies.—a. Ultimate Analysis.

Elementary Analysis of Sparingly Combustible Bodies by Means of Kopfer's Process.—W. Demel.—To prevent the liberation of carbon in the boat the author covers it with three or four times its weight of well-ignited platinum black.

Determination of the Total Nitrogen in Liquids and Solids.—W. Bettel.—From the CHEMICAL NEWS.

Modification of the Varrentrapp-Will Process for Determining Nitrogen.—A. Guyard (Hugo Tamm).—From the CHEMICAL NEWS. J. Ruffle (CHEMICAL NEWS) and R. Kissling (*Chemiker Zeitung*) pronounce Guyard's method impracticable.

Determination of Proximate Constituents.

Quantitative Separation of Fats and Resins.—T. S. Gladding.—From the CHEMICAL NEWS.

Detection and Determination of Hydrocarbons in Fatty Oils.—A. H. Allen.—From the CHEMICAL NEWS.

Determination of Olefines in Petroleum, Shale Oils, &c.—A. H. Allen.—From the *Analyst*.

Quantitative Determination of Pilocarpine.—An account of the methods of Pöchl and Christensen.

Determination of Alkaloids as Picrates.—Dr. Hager.—The precipitation is best effected by adding a saturated solution of picric acid to the aqueous solution of the sulphates of the alkaloids. The precipitates are washed with the same saturated solution of picric acid, dried between blotting-paper, washed with petroleum ether, and dried below 40°.

Special Analytical Methods.

Determination of Salt in Sea-Water.—H. Tornøe.—After drying for twenty hours in an air-bath at 170° to 180°, the residue still contains 15 m.grms. water per grm. of salt, whilst so much magnesium chloride had been decomposed that the quantity of magnesia found per grm. was sufficient to neutralise 20 m.grms. hydrochloric gas. To meet this difficulty Tornøe proceeded as follows:—Into a tared porcelain crucible provided with a well-fitting lid, 30 to 40 grms. sea-water were weighed, evaporated in the water-bath, and, after the salts were well dried, the crucible, covered with its lid, was heated for about five minutes over a Bunsen lamp, cooled, and weighed again. The salts were then dissolved in a measured quantity of standard sulphuric acid, and the free magnesia formed by the decomposition of magnesium chloride is determined by titrating back with dilute soda-lye of known strength, using rosolic acid as indicator. From the figures obtained the total saline matter of the sea-water is calculated.

Chemical Examination of Tobacco Smoke.—J. Molnar.—This work is merely mentioned without a notice of its contents.

Determination of Iron in Ores.—L. Pszczolka.—The author makes up the solution of ferric chloride obtained from 1.5 to 2 grms. ore to 250 or 500 c.c.; measures off two portions each of 25 to 50 c.c. into flasks each holding about 150 c.c., boils to expel air, lets cool, and adds cautiously drop by drop sodium carbonate, till the contents of the flasks are of a deep vinous yellow. The solution is then only faintly acid, which is very important for the subsequent titration. After adding from 1 to 1.5 grms. solid potassium iodide, solution of sodium hyposulphite is added from a burette, turning the flask round and round till the colour of the iron solution is of a very faint yellow. About 1 c.c. of a thin boiled starch-paste is added to each flask, and the titration with sodium hyposulphite is continued drop by drop, slowly raising the temperature to from 60° to 70°, until the colour of the solution entirely disappears.

Examination of Asphalt.—D. Claye.—The author dissolves the sample in carbon disulphide, evaporates the filtrate to dryness, and heats till the residue can be ground to a fine powder; 0.1 grm. of this powder is digested for twenty-four hours with 5 c.c. fuming sulphuric acid, then mixed slowly with 10 c.c. water, applying cooling agents, filtered, and diluted with 100 c.c. water. Pure asphalt gives a colourless or pale yellow liquid; in presence of pitch or coal-tar it is dark brown or black. For the detection of tar-pitch in asphalt, H. Hauschild heats the

sample to 200°, and shakes it with 5 c.c. alcohol. If only 2 per cent of pitch was present, the liquid has a distinct yellow colour with green fluorescence, which becomes more intense as the colour increases.

Removal of Grease from Iron Filings.—A. Ledebur.—To obtain iron filings and borings free from organic matter and dry, they must be ignited in a current of dry and pure nitrogen gas.

MISCELLANEOUS.

Royal Institution.—Mr. H. Heathcote Statham will give the first of two lectures on "Music as a Form of Artistic Expression," on Saturday, March 10. The subject of Prof. Tyndall's discourse on Friday evening, March 16, is "Thoughts on Radiation, Theoretical and Practical."

Fire Protection.—The premises of Messrs. Kernball, Bishop, and Co., Three Mill Lane, have been furnished with fire hydrants and hose, as well as Brigade hand fire-pumps and buckets, by Messrs. Merryweather and Sons, of Long Acre. Messrs. May and Baker's Chemical Works at Battersea are fitted with similar apparatus, which proved the salvation of their premises on the occasion of a recent outbreak of fire.

MEETINGS FOR THE WEEK.

MONDAY, March 5.—London Institution, 5.

Medical, 8.30.

Society of Arts, 8. Cantor Lectures. "Solid and Liquid Illuminating Agents," by Leopold Field.

Royal Institution, 5. General Monthly Meeting.

Society of Chemical Industry, 8. "The Conversion of Oleic Acid into Palmitic Acid on the manufacturing scale," by W. Lant Carpenter.

TUESDAY, 6th.—Royal Institution, 3. "The Supreme Discoveries in Astronomy (The Law of Gravitation)," by Professor R. S. Ball.

Institution of Civil Engineers, 8.

Pathological, 8.30.

WEDNESDAY, 7th.—Society of Arts, 8. "The History of the Piano-forte," by Mr. A. J. Hipkins.

Geological, 8.

Pharmaceutical, 8.

THURSDAY, 8th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.

London Institution, 7.

Royal, 4.30.

Society of Arts, 8. "Self-Purification of River Waters," by W. N. Hartley, F.R.S.E.

Philosophical Club, 6.30.

FRIDAY, 9th.—Royal Institution, 8. "The Ultra-Violet Spectra of the Elements," Prof. G. D. Liveing, at 9.

Astronomical, 8.

Quekett Club, 8.

SATURDAY, 10th.—Royal Institution, 3. "Music as a Form of Artistic Expression," by Mr. H. H. Statham.

Physical, 3. "On a Method of Measuring Electrical Resistances with a Constant Current," by Sh-lford Bidwell. "On some Uses of a New Projection Lantern," by Mr. W. Lant Carpenter.

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JOURNAL OF PHYSICAL SCIENCE.

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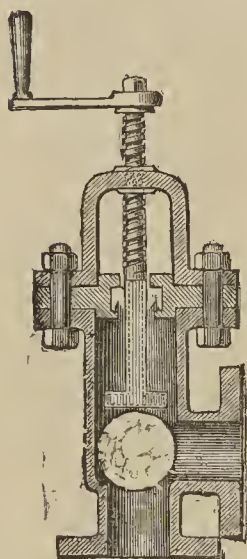
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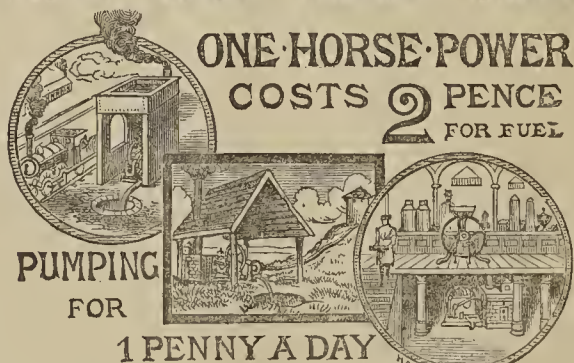
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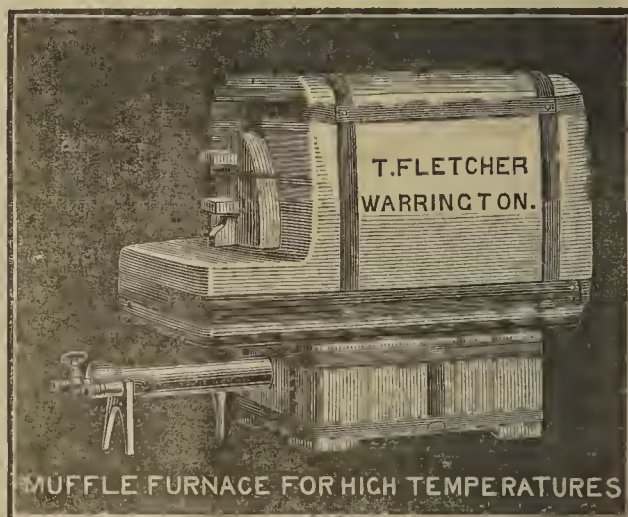
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THE CHEMICAL NEWS.

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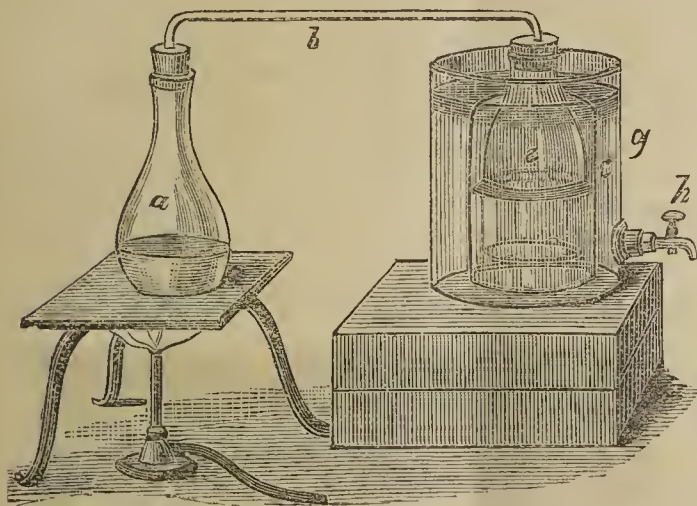
PROCESS FOR THE DETERMINATION OF AMMONIA BY DISTILLATION.

By Dr. O. KNUBLAUCH.

METHODS for the determination of ammonia must, along with the greatest possible accuracy, be capable of rapid execution, and permit the use of easily managed apparatus. Though the method I have hitherto followed left nothing to be desired in the way of accuracy, it did not fulfil the two other conditions in such a degree as the frequent recurrence of these determinations rendered desirable.

I have succeeded in overcoming these defects, so that a distillation may be completed in twelve to fifteen minutes with the apparatus to be described, so as to yield strikingly concordant results.

The apparatus will be readily understood from the accompanying figure. *a* is the distillation flask, holding about 200 to 250 c.c. It is connected by means of a tube, *b*, bent twice at right angles with the absorption-vessel, *c*: *c* differs essentially from the ordinary kind of absorption-vessels. The tube is secured by means of a caoutchouc stopper at *d* in the cylinder *e*, which narrows above and is open



below. This cylinder below has a width of about 40 m.m., and is bent outwards at its margin in several places like the lip of a beaker. The escaping gas bubbles are thus better divided. Above there is fixed round the neck of *c* a cork disc at *d* (movable with a wedge), through which the cylinder lies against the outer vessel *e* in such a manner that *e* reaches to some millimetres from the bottom. This entire absorption apparatus is set in an outer vessel *g*, which is filled with cold water for cooling. The water can be run off as often as is desired by the cock *h*, and cold water run in its stead.

The following example of the determination of the ammonia in a sample of crude ammonium sulphate is added. 20 grms. of the salt were dissolved in 500 c.c. of water; of this liquid 25 c.c., corresponding to 1 grm. of the salt, are introduced into the flask *a*, and its sides are rinsed down with about 10 c.c. of water. The absorption-vessel is charged with normal sulphuric acid, taking a few c.c. more than necessary to neutralise the ammonia given off from 1 grm. As ammonium sulphate contains more than

24 per cent of ammonia, more than $\frac{24}{0.017 \cdot 100} =$ more than 14.12 c.c. of acid must be used. After adding a few drops of rosolic acid, and so much water that the internal cylinder may dip about 1 c.m. into the dilute acid, the absorber is placed in the cooler, and connected with the

flask by the tube *b*, a piece of potassium hydroxide being placed at the same time in the flask. I wrap the potassa in a piece of filter-paper, having observed that the liquid then boils much more quietly, as the paper floats upon the surface and breaks up the steam-bubbles. It is convenient to add a little solution of rosolic acid to the flask *a*: after the distillation is at an end the contents of *a* must still have an alkaline reaction, a proof that a sufficiency of potassa has been added. Instead of solid potassa normal alkali of known strength may be used, always in sufficient excess. The apparatus is set so that *b* slopes upwards slightly towards *c*. In distilling a tolerably strong heat may be applied at the beginning. The air escapes first in large bubbles; then the liquid merely rises and falls, bubbles seldom escaping, and the surface absorbs almost all the ammonia without much agitation. If the bulk of the distillate increases too much, then to reduce the pressure the inner cylinder may be raised a little, and secured by means of the little wedge. After from one-half to one-third of the liquid in *a* has distilled over the flame is extinguished, the tube *b* is disconnected, and when sufficiently cold the residual acid is titrated in the absorbing vessel itself. No part of the apparatus requires rinsing. —*Zeitschrift für Analytische Chemie.*, vol. xxi., p. 161.

REACTIONS FOR THE RECOGNITION OF THE RESORCINE COLOURS.

By R. BENEDIKT.

THE commercial eosines may be readily distinguished from each other by their behaviour with zinc-powder and ammonia and with boiling potassa. The experiments with zinc-powder and ammonia are most conveniently conducted as follows:—Some drops of a moderately concentrated solution of the dye are diluted with water in a test-tube, a few drops of ammonia and some zinc-dust are added, and shaken up. All the eosines are entirely decolourised, even in the cold. The colourless liquid, filtered from the excess of zinc, is for the most part oxidised slowly on exposure to the air, but the colour returns quickly on boiling, till a copious deposit of zinc hydroxide is formed, adding hydrochloric acid to dissolve this precipitate, and again supersaturating with ammonia. The potassa employed for testing should have the specific gravity 1.30. It occasions precipitates in the concentrated solutions of some colouring matters, and on boiling it occasions characteristic changes of colour.

The same reactions serve as a key for the discovery of eosines when fixed upon cloth. A few square centimetres of the dyed tissues are stripped with hot water, to which a few drops of ammonia or potassa have been added, and the liquid, poured off from the cloth, is tested in the same manner as the solution of a dye. Eosines soluble in alcohol are but very slightly stripped by water, but readily by means of alcohol. Those soluble in water are not touched by alcohol.

The following resorcin colours have been examined:—

- Eosine G (tetra-brom-fluoresceine potassium).
- Eosine B (tetra-iod-fluoresceine sodium).
- Eosine B N, safrosine (brom-nitro-fluoresceine sodium).
- Erythrine (potassium salt of mono-ethyl-tetra-brom-fluoresceine).
- Phloxine (tetra-brom-dichlor-fluoresceine potassium).
- Rose bengale (tetra-iod-dichlor-fluoresceine sodium).
- Cyanosine (potassium salt of mono-methyl-tetra-brom-dichlor-fluoresceine).
- Chrysoline (benzyl-fluoresceine sodium).
- Phloxine, rose bengale, and cyanosine are derivatives of a dichlor-fluoresceine which is produced with dichlor-phthalic acid.

The sample of dye under examination is digested with zinc-powder and ammonia and filtered.

(1.) The filtrate quickly takes a crimson colour without fluorescence. A fresh portion, boiled with potassa, becomes at first more fluorescent, then turns olive without fluorescence, and on dilution with water becomes greenish without fluorescence. The original solution has a green fluorescence: Eosine B N (safrosine).

If the filtrate becomes coloured very slowly, boil till the white precipitate is formed, and add hydrochloric acid and ammonia. The liquid is coloured and fluorescent. Examine further as in (2).

(2.) The liquid by transmitted light has the same, or nearly the same, colour as the original solution when equally diluted. See (3).

The liquid is slightly reddish yellow with decided yellowish green fluorescence, whilst the original solution is crimson without fluorescence. See (5).

(3.) Liquid and original solution both yellow, with decided yellowish green fluorescence. No change on boiling with potassa: Chrysoline. The liquid and original solution crimson if sufficiently diluted; the liquid with a yellowish green fluorescence; the original solution with orange; yellow or yellowish green fluorescence: any of the bromiferous eosines. See (4).

(4.) *a.* Potassa causes no precipitate, but on heating turns violet with green fluorescence, and *before* the temperature reaches a boil, blue with green fluorescence. On dilution with water, likewise blue with green fluorescence. The dye soluble in water, and not stripped from the fibre by alcohol: Eosine G.

b. Concentrated potassa precipitates most of the colour; the liquid is opaque, but fluoresces strongly orange. On boiling the same changes ensue as with eosine G, but far more slowly, so that the liquid must boil for some time before the blue appears. The colour dissolves with great difficulty in cold water; soluble in dilute alcohol with very strong yellow fluorescence. Water strips the dyed cloth slightly; alcohol abundantly: Erythrine.

c. Potassa gives a purple-red turbidity in the cold; on heating the liquid becomes first violet with yellowish green fluorescence; on boiling blue, *without* fluorescence; similarly on dilution with water. The dye is soluble in water, and is stripped from the fibre by water, but not by alcohol: Phloxine.

d. Potassa effects an almost complete precipitation; the liquid fluoresces less strongly than in the case of ethyl-eosine. On boiling the change of colour does not go beyond a violet-blue, and the liquid looks dull unless it contains very little colour. On dilution with water, violet with yellow fluorescence, which becomes stronger on the addition of alcohol, and the liquid turns to a redder shade. The dye dissolves in alcohol with very strong orange-yellow fluorescence: Cyanosine.

5. Potassa gives a slight turbidity. On boiling the liquid becomes first purple, then violet, and blue with green fluorescence, lastly brown. On dilution with water very slightly coloured, with strong fluorescence. The dye is soluble in water: Eosine B.

Potassa gives a slight turbidity. The liquid on boiling, blue without fluorescence (on dilution purple-violet); on further boiling dirty-violet (on dilution purple with slight fluorescence): Rose Bengale.—*Chemiker Zeitung: Coethen.*

Sophistication of Quinine Sulphate.—The quinine sulphate supplied to the hospitals of Paris has been found curiously deceptive. At the top and at the bottom of the box was a stratum of the salt required, of good quality, but the intervening space was filled up with cinchonine sulphate. The French firm who supplied the drug profess ignorance of the fraud, and assert that the boxes were supplied to them ready filled by a house at Milan, which has been recently amalgamated with a German manufactory. The matter is said to have occasioned some diplomatic ink-shed.—*Les Mondes.*

REPORT ON GAS BURNERS.*

By THOMAS FAIRLEY, F.R.S.E.,
Public Analyst and Gas Examiner.

THESE tests have been made with gas averaging about 17.5 candles,† and corrected for variations in temperature and pressure which affect the measurement of the gas.

The certified Methven unit has been employed, checked by frequent comparison with the best standard candles. The Methven unit is more constant than any candles, and gives the best standard for burner tests known at the present time.

The burners tested are of four kinds, each with modifications by different makers. The "union jet" or "fish tail"; the "batwing"; the "slit union" or "flat flame"; and the "Argand." These are each made with or without a check at the bottom of the burner to diminish the pressure, or with or without a small governor attached to each burner to keep the consumption constant.

The Siemens regenerative burner is somewhat different from any of these, but is a modified Argand with fittings for heating the gas and air by the waste heat of the flame. This principle was first applied, many years ago, by Leslie and by Faraday, and gives an increase of from 30 to 60 per cent in the light obtained.

As a rule, burners with governors are preferable to burners without them, even where a governor is attached to the meter. Any burner with too little gas is flickering and unsteady, and often smoky, and with too much gas it is also wasteful and generally smoky. Each burner has a particular pressure at which it gives its best results.

The burners most sensitive to variations of pressure are the union jets and the Argands. These are much improved by a check or governor attached to the burner. Where a very steady uniform localised light is desired, and a burner not very sensitive to the effects of dust, the union jet may be employed, but it gives less light for the gas consumed than the other burners, especially with the smaller sizes.

The slit burners are more sensitive to dust, but the proportion of light obtained per foot of gas equals or surpasses in some instances that obtained from the Argands.

The Argands require more care and attention than any other form. Unless reflectors are used, the light is given off chiefly in the horizontal plane of the flame so much that it is much darker above or below the burner. The chimney glasses require daily cleaning.

An Argand is more smoky than any other burner if too much gas is supplied to it, and gives exceedingly little light when the supply is too small.

Some makers send out duplex burners (two small burners mounted so that the flames coalesce). These burners are smoky at low pressures, giving a flame of the same character as that from a large-sized ordinary burner with too small a supply of gas. At higher pressures, 1.5 ins. and upwards, they give better results, but not superior, or often so good, as those obtained from the best single burners.

To meet the requirements of consumers who wish to get the best results at a given consumption, I have attempted to classify the results, naming the burners which give the maximum light at each consumption, without undue smoking.

None of the batwing burners are suitable for globes, while the union jets and slit unions or flat flames are suitable. No globes should have an opening, at the bottom, of less than three inches, otherwise a great part of the light is lost. Mica or porcelain tops placed over the globes help to increase the light and to diminish the production of smoke.

* Presented to the Gas Committee of the Council of the Borough of Leeds, November 16, 1882.

† When tested by the 15-hole Argand burner according to the conditions of the Leeds Gas Act.

For consumers wishing to consume gas at a given rate in each burner, I beg to point out the results obtained from—

2 to 3 Feet per Hour.

Retailed at

Bray's No. 1, plain and special slit unions, 1d. and 3d.	
Sugg's "Winsor" check burner, No. 3	1/0
Borradaile's governor burner, 2 feet	2/6
Brönnner's 4 A-top	1/6

3 to 4 Feet per Hour.

Bray's Nos. 1 and 2 special slit unions and special batswings	3d.
Bray's No. 2, union jet (special)	3d.
Sugg's Christiana governor burner, No. 3 .. 3/6 to	5/6*
Peebles' governor burner, No. 3	1/6*

4 to 6 Feet per Hour.

Bray's No. 3 special slit union; Nos. 3 and 4 special batswings	3d.
Sugg's Christiana, No. 5	3/6 to 5/6*
Sugg's check burners Nos. 4 and 5	1/0
Sugg's London Argands	5/6 to 8/0
Borradaile's 5 feet governor	2/6
Peebles' Nos. 4, 5, and 6	1/6

6 to 10 Feet per Hour.

Bray's slit unions and batswings, Nos. 4, 5, 6, 7, 8, and 9, plain and special	1d. and 3d.
Bray's union jets (special), 4, 5, 6, 7, 8, and 9 ..	3d.
Brönnner's No. 5 B top	1/6
Silber's duplex batswings, at high pressures only ..	1/6
Peebles' governors, Nos. 6, 7, and 8	1/6
Sugg's Christiana, No. 6	3/6 to 5/6
Siemens's flat flame burner	£4

Above 10 Feet per Hour, for Street Lighting, &c.

Bray's large burners	
Siemens's regenerative burners, £7 10s. and £10 each	

* Without globes.

THE TECHNICAL ASPECTS OF LIGNIFICATION.*

By C. F. CROSS.

THE subject upon which I have undertaken to address the Society is one of fundamental importance, whether regarded from the technical or the more purely scientific side. The latter involves the consideration of the plant as the great synthetical laboratory of the natural world, and of cellulose and lignose as the most extensive products of this synthetical activity; on the other hand, cellulose and its lignified derivatives constitute the raw material for what are amongst the most important trades of a civilised community, viz., the manufacture of paper and textile fabrics from vegetable fibrous materials. While, in dealing with this subject, it will be necessary to confine ourselves as closely as possible within the limits expressed by the title, the object contemplated in its selection cannot be compassed with exclusion of theoretical considerations; for it is necessary to show that the methods in general use for the treatment of cellulose substances involve a general principle; and that this principle is the reverse of that which is based rather upon a knowledge of their chemical constitution than upon an empirical observation of certain changes wrought upon them by reagents, and is, therefore, the foundation of a more rational treatment.

In order to elucidate this central antithesis, it will be necessary to trace, briefly, the development of our present system of cellulose technology. As our chemistry is by nature what we may term a water and oxygen chemistry,

so we find that our chemical processes of treating vegetable fibres, for the purpose of adapting them to their finest uses, having been evolved from observation of the action upon them of substances and under conditions the most readily available, are dominated by water and oxygen. In this process of evolution, we mark the following stages:—(1.) The observation of the natural isolation of fibres by the process of dew-retting. The greater number of vegetable fibres used in the arts are obtained from compound structures of which they are constituents. First in order of biological simplicity stands the large group of bast fibres, usually of great length, and, as they occur, ordered into a more or less compact tissue, lying beneath the bark. Next we have the fibrovascular bundles of monocotyledonous plants which are scattered throughout the cellular matrix of the stems and leaves; and lastly, the biological complex, wood. The fibres of the two first divisions are alone available for textile purposes, and their isolation from the cellular matter with which they are associated, is frequently seen to be accomplished by the natural or unaided process of retting. The ingenuity of man is not slow, even its earliest phases of development, to take advantage of the materials thus brought to hand, and then to aid nature in bringing these structures in contact with water, under regulated conditions, so as to secure the most advantageous results. The fibrous character of wood is also revealed by the process of dew-retting, and the product, though unavailable for human use, is not lost sight of by the hornet and other insects who employ it in making their nests.

In the next stage, we may include the manipulation of the isolated fibres into articles of clothing and domestic use, the washing of these in cold water, and, as the result of growing observation, in hot water, with the addition of wood ashes. The prosecution of these processes involves experience of their softening action, together with the bleaching effects of exposure to air and light in the process of drying. An extension of these rudimentary methods will be seen to include our modern processes of scouring cellulose fabrics.

The employment of fibres, isolated from wood, plays no part in the general process of the evolution of this special knowledge, and we must therefore defer its consideration in passing on to the third stage of progress.

The application of chlorine, and subsequently chlorine compounds—the hypochlorites of the several bases—to the bleaching of cellulose substances, completes the chain of development of the natural or oxidation method, which is now firmly and universally established.

It has long been held that the action of these hypochlorites upon the colouring and other adventitious matters which they remove is one of oxidation, and a confirmation of this, if indeed confirmation were needed, is to be found in the recent application of the permanganates to the same end. The practical value of their application, which is well established in respect of simplicity and certainty, will increase with the increasing cheapness of this source of oxygen. To us it is interesting, as completing the demonstration of the foundation of our present system of scouring and bleaching cellulose fabrics uniformly, upon methods which involve the oxidation of their constituents. These processes, which have so long occupied a position regarded as unassailable, have recently come under suspicion, and in their empirical extension to substances other than, and yet similar chemically to, those with which they yielded results of general excellence, have led to observations which suggest the necessity of a revision.

First, in the application of calcium hypochlorite to the bleaching of jute, it was found that, under certain circumstances, chlorine compounds of the fibre constituents were formed. This difficulty, however, was easily overcome by substituting soda for lime; but a second difficulty yet remained in the experience that jute fabrics, bleached by means of the soda compounds, underwent further changes when exposed in the dry state to the atmosphere, and that

* A Paper read before the Society of Arts, January 25, 1883.

when such fabrics were steamed, as in the calico printing processes, these changes were intensified, and made evident by considerable discolouration, and often by disintegration; the latter effect requiring, in many cases, a subsequent exposure to the atmosphere of varying duration, for its more complete manifestation. The cause of these phenomena was found to lie in certain constituents of the fibre substance, which have the property of absorbing oxygen to form acids; and an effective remedy was discovered in impregnating the fabrics with alkaline sulphites, the reducing action of which arrested the tendency impressed upon the fibre substances by the oxidising value of the bleaching processes, and the presence of which was found to counteract the disintegrating effects of long exposure and of the action of steam, previously experienced. We must content ourselves with a passing notice of this point, which will be found fully treated elsewhere, in order to give greater prominence to the discussion of the second count in the indictment of the oxidation method of treating vegetable substances for the isolation of cellulose. This is afforded by the history of the process of treating wood for the preparation of paper pulp. These processes have recently advanced to a position of considerable importance, and the experience upon which they have been developed is not only of great interest technically, but throws light upon a number of the recondite problems of plant chemistry. It will be seen, as we proceed, that this experience has been closely similar to that which was worked out in the case of jute; a fact which is to be regarded not merely as a coincidence, but as the necessary consequence of the close similarity in chemical composition of the substances in question; and the occurrence of similar difficulties, leading to the adoption of similar remedies, as a result, moreover, of altogether independent investigations, will contribute very much to the recognition of the necessity of revising our cellulose technology, upon the principles which they go to establish.

To elucidate these more clearly, it will be necessary to give a brief survey of the chemistry of the compound celluloses from a theoretical point of view, which has been arrived at through a variety of contributory agencies:—(1) the conclusions of physiologists with regard to the chemistry of the development of cellulose and its derivatives; (2) the verification by chemical research of these conclusions; and (3) an independent study of cellulose and lignose as isolated individuals.

Cellulose, in the form of bleached cotton, is a well-defined body, the properties and characteristics of which are too familiar to need recapitulation. Bleached linen, on a general presumption of the identity of the celluloses, has been regarded as identical with cotton. The treatment of these fibres, on the other hand, proceeds upon the recognition of considerable differences between them; and while these have not yet found definite chemical expression, they are sufficiently evident to point to the individuality of the members of the group of celluloses. This, we hold, constitutes the only satisfactory basis of their technology. Biologists necessarily ignore these differences, and understand by cellulose a substance having those properties which chemists regard only as typically characteristic; these are chiefly external appearances, and the blue colouration which it gives with Schulze's solution. Such a substance appears to constitute the original form of all plant fibres, as indeed of the skeleton generally; and although varying with the condition of its elaboration and hydration, these variations may be regarded as comparatively unessential. The phenomenon of lignification is superinduced upon this cellulose basis, and, according to recent views, through a process of intrinsic modification. A very simple type of this process, if not the simplest, is to be found in the jute fibre, the chemistry of which, as already indicated, involves to a large extent the chemistry of wood. A recapitulation of its chief properties, parallel with those of cellulose (cotton), will give a concise view of the more conspicuous chemical changes involved in lignification:—

	Cellulose (cotton).	Lignose (jute).
1. Carbon-percentage	44	47
2. Action of chlorine (moist)	Oxidises	Oxidises and chlorinates.
3. Action of dil. acids at 70°	hydrocellulose.	Resolves into soluble modification and ultimately furfural, &c.
4. Action of nitric acid ($\text{HNO}_3 + \text{H}_2\text{SO}_4$)	Forms colourless explosive compounds	Forms yellow coloured explosive compounds.
5. Reaction with aniline sulphate	Nil.	Yellow colour.
6. Reaction with Schulze's solution	Blue colour.	Brown colour.

These are the main features of the evidence which goes to show that in the process of lignification the typical characteristics of the original cellulose are maintained; and, moreover, that lignified fibres are not composed of cellulose mixed merely with adventitious or encrusting substances which mask its ordinary reactions, but that they are made up of cellulose, or a cellulose "residue," in a state of intimate chemical union with molecules, which confer upon them their special features of difference. Of these we may select, as having a more direct bearing upon our subject: (1) the formation of the peculiar aldehyd, known as furfural, under digestion with dilute mineral acids at 60° to 80° C.; and (2) the formation under the action of moist chlorine of chlorine-substitution derivatives, which appear to have close connections with the trihydric phenols. On the latter of these we need say but a few words. Although phenol derivatives are formed from the jute fibre substance, the evidence goes to show that it contains actually no aromatic constituents, no derivatives of such having been obtained by any process of modification other than that of chlorination—or, at least, only in insignificant quantity. Woods, on the other hand, do contain aromatic substances, many in large proportions; of these we may mention many colouring matters, astringents, and glucosides.

The former property, of yielding furfural, and under such conditions as cannot involve any radical chemical change, leads to the very important conclusion that processes for the treatment of lignified fibres, which in any way involve chemical modification, should have strict reference to the aldehyd character of the substances of which these are built up, or, to express it more correctly, to the fact that the immediate products of the hydrolytic resolution of the lignified celluloses are aldehyds of the furfural type.

The aldehyds, as is well known, represent the intermediate stage of oxidation of an alcohol to its corresponding acid. This essential incompleteness is the cause of their characteristic properties, viz., (1) the avidity with which they combine with oxygen to form acids; (2) tendency of union of like molecules to form polymeric modifications; (3) tendency to synthetical union with other molecules to form complex derivatives, which are frequently coloured and generally resinous in character; (4) tendency to cumulative resolution, or condensation with elimination of the elements of water. These properties confer upon the aldehyds a condition of "chemical tension," which, as has been recently theorised, plays an important part in the synthesis of proteid substances in the living organism; and an extension of this conception of the chemistry of life may reasonably be anticipated in regard to the substances we are considering, and, therefore, to the whole work of building up vegetable structures. We must, however, refrain from a somewhat speculative discussion, and turn to the practical applications of our observations.

The treatment of jute in the manner already described, follows as a simple deduction. The presence of sulphurous

acid antagonises the oxidising action of the conditions to which the fibre is subjected, exposure to which is otherwise extremely prejudicial, inducing decomposition in the manner already described.

Of much greater practical importance, however, are the processes for treating wood and other resistant vegetable substances for the preparation of paper pulp, and the modifications of these, which we can show to follow from what is known of the composition of these fibrous structures. Up to within a comparatively recent period, these processes have consisted uniformly in a drastic treatment with alkaline solutions; the process of boiling under pressure with caustic soda, originally applied by Routledge to esparto, has been generally extended and adopted, and is, indeed, the standard method of treating lignified substances for paper-making; efforts to substitute this process by one based upon the principle of reduction or anti-oxidation have been made by one or two technologists, who at the same time, do not appear to have approached the subject from the same point of view. The subject appears to me to have been developed most consistently by Fry and Ekman, and as their labours have had strict reference to the principles under discussion, their treatment will occupy the prior place.

Fry commenced the investigation of this subject about 17 years ago. He was familiar with Houghton's process, the object of which was to throw the work of disintegrating the wood upon the agencies other than the alkali, which latter it was found could be proportionately reduced in quantity. Fry was led to investigate the resolving action of the water alone, under the guidance, not unworthy of mention, of a passage in Faraday's "Manipulation," which directs the chemist, in analysing a mixture, to adhere to the method of preliminary separation by means of solvents successively applied, of these water being the first. It was found that water, at a sufficiently high temperature and pressure (70 lbs. of steam), exerted a very considerable disintegrating action, sufficiently indeed to produce a pulp well-adapted to the manufacture of brown paper; also that of the soluble products of resolution a large proportion were acid bodies. The following statistics, having reference to the two processes, are worth reproduction, the wood operated upon being in both cases that of the common *Pinus sylvestris* :—

(1). *Houghton Process*.—5378 parts (dry) wood, yielded 1787 parts dry pulp=33 per cent.

(2). *Water Process*.—6338 parts (dry) wood, yielded 4424 parts dry pulp=70 per cent.

To neutralise the solution from the boiling (2), 1000 parts $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ = 216.8 parts Na_2O were required. The acids formed in such large quantities were partly volatile, *i.e.*, of low molecular weight, and derived from the substituting or side groups in the original molecule of the wood substance, and partly acids of high molecular weight, exhibiting derivation rather from the central nuclear carbohydrate group.

These acids are formed by the hydrolytic resolution of the wood substance, accompanied by oxidation at the expense of atmospheric oxygen, or it may be also of oxygen derived from other portions of the wood substance itself. It is also evident that the acids, when formed, must react on further portions of the wood substance, and aid in its resolution and disintegration.

A number of the by-products obtained in this process were also investigated. It has already been stated that the chemical constitution of wood is, in the main, identical with that of jute; this identity we may express more precisely as limited to the ground substance of the wood; and the decomposition of this by the action of the superheated water, gives rise to some quantity of furfural and other aldehyds, which were collected, in Fry's experiment, by means of an elaborate condensing arrangement. These aldehyds were accompanied by a number of other volatile products, boiling below 100°C ., which have not yet been fully investigated. These are derived partly from the ground substance, and partly from the resinous

and other characteristic constituents of the wood, which may be considered as distinct from the ground substance. With regard to the aromatic substances, in the presence of which the woods show a further distinction from the bast fibres, these were so far complicated by combination with the aldehyds which are formed during the process, as to be in a condition altogether unfit for investigation.

As regards the resolution of their ground substance, or lignose, as it is termed, the woods resemble very closely the jute fibre, and those substances which are allied to it. A comparison of these fibres with one another, in relation to the action of superheated steam upon them, and the percentage of their substance thereby converted into soluble products, has been made by Dr. Forbes Watson, with the results contained in the table.

The interesting point to be noticed is that the loss per cent follows the order of the fibres, in respect of lignification. Although these investigations were not extended to woods, it is known from other sources that their behaviour affords an additional proof of this statement.

The process of disintegrating the wood by means of water, at elevated temperatures, was worked to a practical issue, and a mill was put up at Bergvik, in Sweden, for the manufacture of "half-stuff" for brown paper. At the same time, investigations were continuously prosecuted with the view to increase the solvent action of the water, and thus to arrive at a product more nearly approaching cellulose. It became more and more evident that the condition of oxidation was especially inimical to this end, and to antagonise it by the presence of a reducing agent was the purpose which underlay the next series of experiments. These were carried out by Ekman, and his choice of a reducing agent soon fell upon sulphurous acid, a choice, which was perhaps, in the first instance, determined by a natural fitness on the side of economy, but is now seen to have the more important function conditioned by the peculiar relationship of the sulphites to the aldehyd products of resolution of lignose. The results which followed from this modification, the removal of a further 20 per cent of the non-cellulose constituents of the wood, and the production of a residue which is but little removed from pure cellulose, are now matters of common knowledge. The special commercial advantages which this process offers, *viz.*, the power to employ a raw material at £2 to £3 per ton, from which 40 to 50 per cent of a pulp is obtainable, suitable for all classes of paper; the use of reagents of little cost; and the production of a solution of the non-cellulose constituents, from which, doubtless, valuable products are to be isolated, or which, at least, will cause no detriment to the water-courses into which it may be run, are sufficiently obvious to have already commanded considerable attention from practical men.

The Ekman process differs from the water process, in the sole particular of the presence of the magnesium sulphite; and the function of this salt appears to be, not so much to aid positively in the resolution of the wood, as to prevent the degradation of its constituents in virtue of the reducing activity of its sulphurous acid, and the property of the entire salt of forming compounds with certain of the non-cellulose constituents which enter into solution. In other words, the water, at the elevated temperature at which it is employed, appears to be the effective solvent; but while, under ordinary circumstances, this solvent action reaches a limit determined by the formation (by way of oxidation and synthetical combination) of secondary derivatives, which resist the solution, these secondary changes are obviated by the presence of the sulphite, and the resolving action of the water is allowed to proceed unimpeded.

Other processes for resolving wood by means of solutions of sulphites have been patented, and worked with more or less success. Upon the exclusively practical question of deciding as to the relative merits of these, it is not for us to speak. We may, however, inquire from what point of view their originators have investigated the matter, and therefore, so far as a study of their specifica-

TABLE SHOWING THE COMPARATIVE RESISTING POWER OF VARIOUS INDIAN AND SOME OTHER FIBRES UNDER THE ACTION OF HIGH-PRESSURE STEAM AND BOILING WATER.

(Fibres arranged in order of effect produced, commencing with those least influenced).

Experiment No. I.			Experiment No. II.			Fibres Arranged in Order of Total Loss Produced by both Experiments.		
No.	Name.	Loss per cent after exposure for 2 hours in steam, at 15 lbs. extra pressure; followed by boiling in water (212°) for 3 hours.	No.	Name.	Loss per cent after further exposure, for 4 hours, to steam and water at 15 lbs. extra pressure.*	No.	Name.	Total loss per cent.
1.	Himalayan Hemp† (<i>Cannabis sativa</i> ?)	0.58	1.	China Nettle ..	None	1.	Himalayan Hemp†	0.77
2.	Rheea (<i>Boehmeria nivea</i>)	0.81	2.	Neilgherry Nettle ..	None	2.	China Nettle ..	0.89
3.	China Grass (<i>Boehmeria nivea</i>)	0.89	3.	Sunn	None	3.	Rheea	1.51
4.	Ambaree (<i>Hibiscus cannabinus</i>)	2.39	4.	Himalayan Hemp†	0.19	4.	Neilgherry Nettle	2.85
5.	Flax (<i>Linum usitatissimum</i>)	2.47	5.	Ejoo	0.61	5.	Sunn	2.93
6.	Pine Apple (<i>Ananassa sativa</i>)	2.47	6.	Rheea	0.70	6.	Flax	3.50
7.	New Zealand Flax (<i>Phormium tenax</i>)	2.70	7.	Flax	1.03	7.	Ambaree	3.63
8.	Pita or Agave (<i>Agave Americana</i>)	2.72	8.	Bedolee Sutta ..	1.20	8.	Ejoo	4.15
9.	Sufet Bariala (<i>Sida rhomboidea</i>)	2.76	9.	Ambaree	1.24	9.	Bedolee Sutta ..	4.26
10.	Neilgherry Nettle (<i>Urtica heterophylla</i>)	2.85	10.	Moorva or Marool	2.03	10.	Muddar or Yercum	5.47
11.	Sunn (<i>Crotalaria juncea</i>)	2.93	11.	Dunchee	2.18	11.	Pita or Agave ..	5.55
12.	Bedolee Sutta (<i>Pedderia fœtida</i>)	3.06	12.	Jute	2.19	12.	Moorva or Marool	5.55
13.	Muddar or Yercum (<i>Calotropis gigantea</i>)	3.19	13.	Muddar or Yercum	2.28	13.	Sufet Bariala ..	6.00
14.	Italian Hemp (<i>Cannabis sativa</i>)	3.38	14.	Coir.. .. .	2.54	14.	Dunchee	6.07
15.	Manilla Hemp (<i>Musa textilis</i>)	3.38	15.	Manilla Hemp ..	2.69	15.	Manilla Hemp ..	6.07
16.	Plantain (<i>Musa paradisiaca</i>)	3.40	16.	Italian Hemp ..	2.86	16.	New Zealand Flax	6.14
17.	Russian Hemp (<i>Cannabis sativa</i>)	3.47	17.	Pita or Agave ..	2.83	17.	Italian Hemp ..	6.18
18.	Ejoo (<i>Arenga saccharifera</i>)	3.55	18.	Sufet Bariala.. ..	3.24	18.	Pine Apple	6.49
19.	Moorva or Marool (<i>Sansevieria zeylandica</i>)	3.72	19.	Plantain.. .. .	3.34	19.	Plantain	6.74
20.	Dunchee (<i>Sesbania aculeata</i>)	3.89	20.	New Zealand Flax	3.44	20.	Coir	8.13
21.	Yucca or Adam's Needle (<i>Yucca gloriosa</i>)	5.30	21.	Pine Apple	4.02	21.	Russian Hemp ..	8.44
22.	Coir (<i>Cocos nucifera</i>)	5.59	22.	Russian Hemp ..	4.97	22.	Yucca or Adam's Needle }	10.87
23.	Pandanus or Screw-pine† (<i>Pandanus odoratissimus</i>).. .. .	6.03	23.	Yucca or Adam's Needle }	5.57	23.	Pandanus, or Screw-pine .. }	12.21
24.	Jute (<i>Corchorus olitorius</i> ; <i>C. capsularis</i>)	19.20	24.	Pandanus or Screw-pine }	6.18	24.	Jute	21.39

* In this case, the samples were partially immersed in the water, and the operation of boiling afterwards, to remove the portions loosened by the steam, was not required. In Experiment No. I., the fibres were placed entirely in the steam, then removed and boiled for three hours in water.

† Although, after careful examination, this is believed to be true hemp, still, looking to the very high place which it takes, as compared with that from Russia and Italy, it is quite possible that this opinion may be wrong. It will be noticed that Sunn fibre, which stands 11th in Experiment No. I., occupies the first rank in No. II. This "Himalayan hemp" is not the produce of a nettle, but it may, as originally suggested by Mr. Henry Cope, be that of the Sunn plant.

† This refers to the white, comparatively weak fibres, furnished by the leaves of the Screw-pine, not to the fibrous material yielded by the aerial roots which shoot downwards from its stem.

tions will permit, to what extent they contribute to the establishment of the general principle upon which they proceed.

In 1866 Tilghman patented a process for the preparation of paper pulp from wood, by heating with sulphurous acid solution, with or without a base, and at a pressure not exceeding that of the atmosphere. In his specification he builds upon two properties of this reagent as especially contributing to the result, viz.—(1) Its bleaching action upon vegetable as upon animal tissues; and (2) its specific action as an acid upon the constituents of the wood. This point of view involves no general theory of the chemical function of the substances operated upon: and the want of success which attended Tilghman's work is referable partly to their somewhat inadequate conception of the theoretical basis of his process. Augustus Mitscherlich took out in 1874 a German patent for treating wood with a solution of bisulphite of lime, and his process has met with considerable success. This chemist, in his specification, wisely avoids theoretical matters; at

the same time, from the statement which it contains that the yield of cellulose from *Pinus sylvestris* amounts to 66 per cent of the weight of the wood, we are enabled to gather (1) that he effects a very incomplete resolution of the wood substance, not much more, indeed, than by means of water at the same temperature as that employed by him; and (2) that he attaches a very different meaning to the term cellulose from that which is current amongst chemists who have investigated this subject from the more purely theoretical point of view. We cannot see, therefore, that either of these processes was instituted upon a clear recognition of the chemical relationship of the reagents. The process also, which bears the name of Francke, is one which addresses itself rather to the main practical end of converting wood into paper pulp than to the establishment of a general principle, and therefore can only claim from us this passing notice.

Whatever be the minor issues of these several processes in their competition one with the other, they all offer a solution of the problem of preparing paper-pulp from wood

under reducing conditions, and constitute, therefore, together with the many obvious points of superiority of the products, both soluble and undissolved, and of its results, economically considered, a very strong indictment of the older methods; added to which, the confirmatory evidence drawn from the theoretical investigations of the constitution of lignified tissues makes the case for the sulphite method complete.

I must not omit to mention that there has been hitherto a practical objection to this process, which has been of sufficient weight to deter many from adopting it, who were on other grounds fully satisfied as to its superiority—this lay in the necessity of using a lead-lined jacketed boiler, a very costly piece of apparatus in the first instance, and one very liable in the next place to get out of order by displacement of the lining, and thus to cause serious interruptions. It has only recently become known to those engaged in developing this process that a metal has been in use now for several years, in the process of manufacturing glucose, which resists the action of dilute sulphuric acid boiling under pressure, and fulfils all the conditions demanded by the sulphite process for wood-pulp. Its adoption removes the only serious objection which could be urged against the many advantages which it offers.

Although we refrain from giving an opinion upon the relative values of the pulps produced by the several sulphite processes, it may aid in the formation of a correct estimate by those who have not given much attention to the theoretical side of the subject, to give a short account of the three chemical tests which afford the most valuable criterion of a pulp, apart from a direct observation of its working into paper. It is evident that its value increases in proportion as it approaches more nearly to the condition of pure cellulose. To detect residual lignose (1) the aniline sulphate test (yellow reaction) has been considered sufficient; but it must be pointed out that the "reduced" pulp often fails to give the reaction, even though it contain a large proportion of lignose, and that the only reliable test is (2) exposure to chlorine gas, followed by immersion in a solution of sodium sulphite, the lignose substances being hereby converted into a bright magenta-coloured derivative. The most reliable method is, however (3), the quantitative estimation of the cellulose by any of the standard methods, together with an observation of the behaviour of the cellulose in regard to boiling alkaline solutions, chiefly the loss in weight sustained on boiling in a solution of potash of standard strength for a constant interval of time. In regard to the latter test, it serves to reveal a very serious defect of some boiling processes, or of any boiling process improperly conducted, viz., the modification of a portion of the cellulose into derivatives having a gelatinous character or tendency, and which render a paper in which they are present brittle and hard. This modification is the result or the expression of a "hydration" of the cellulose, and appears to depend, to a great extent, upon the proportion of base to acid in the sulphite solution. The products in question are soluble in alkaline solutions, and thus the value of the test in revealing a defect which might otherwise be overlooked. Time will not permit us to discuss this question of wood boiling more fully.

In conclusion, we must devote a few words to the cognate subject of the isolation of fibres by means of "retting." This process is one that requires most delicate handling, and that whether the fibres to be separated are of the lignified (jute) or cellulosic type (flax, hemp). Those who are acquainted with the details of the conduct of this process will have been struck with the fact that it continues to be regulated by a traditional empiricism, that, for instance, a product of such great value and importance as flax should be left to the uncertain issues of a process which is calculated to do more or less damage to the fibre, according to variations in conditions which are only very imperfectly understood, and therefore controlled. It has been found, on the other hand, that these fibres can be isolated by means of the process of boiling, under pres-

sure, with solutions of the sulphites, with results which have the great merit of being invariable. The process is simple, and capable of endless variation to suit the special circumstances of any given fibre. In this application, it is, as yet, only in its infancy; but the superior results which it promises call for the careful consideration of practical men, both agriculturists and manufacturers. When it is remembered that huge industries depend upon a first process of an essentially uncertain character; that the raw material which they employ is probably all, more or less, deteriorated by this process; and further, that the difficulties of dealing with the produce stand in the way of developments in agriculture, which might have an important influence on the future of this country, it is surely time that the matter received a thorough investigation.—*Journal of the Society of Arts.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 1, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

The following certificates were read for the first time:—
J. A. Basker, E. C. Hemming, J. B. Coleman.

The full list of Officers and Council was read from the Chair. The changes contemplated are given in the report of the meeting on February 15. In that report the name of Prof. Dittmar was, however, inserted instead of H. T. Brown as a proposed member of the Council.

During the evening a ballot was held, and the Scrutators, Dr. Hodgkinson and Mr. Howard, declared the following gentlemen duly elected Fellows:—A. C. Abraham, G. Board, C. N. Betts, E. Bevan, F. J. Cox, A. Collenette, S. Dyson, W. T. Elliott, H. B. Fulton, C. G. Grenfell, B. F. Halford, W. D. Hogg, D. Hooper, J. J. Knight, H. F. Lowe, T. H. Leeming, J. E. Marsh, W. Newton, C. Rumble, F. Scudder, J. O'Sullivan, S. A. Vasey, T. D. Watson, R. M. Walmsley, C. S. S. Webster, F. Watts.

The following papers were read:—

"On some Derivatives of the Isomeric $C_{10}H_{14}O$ Phenols," by H. E. ARMSTRONG and E. H. RENNIE. Lallemand stated (*Ann. Chem. Pharm.*, 101, 119) that by the action of a mixture of strong nitric and sulphuric acids on dinitro-thymol a trinitro-thymol was obtained. The authors have repeated this reaction, and find that a trinitro-body is produced, but that it is trinitro-meta-cresol, the propyl group being displaced. The authors were unable to trace this reaction. On comparing carvacrol with thymol, it is seen that the only difference is in the relative positions of the methyl and propyl groups. Only a dinitro-derivative could be obtained from carvacrol; no trinitro-body could be formed. An attempt was made to introduce the NO_2 group into the unoccupied ortho-position in thymol-sulphonic acid, but without success, as the sulpho-group is displaced by NO_2 , and para-nitro-thymol is formed. When bromo-thymol-sulphonic acid is oxidised by chromic acid, a quinone is formed; with permanganate no formation of quinone takes place; some amorphous, probably condensation, products are produced. Dibrom-thymol, with cold nitric acid, forms a colourless substance, probably a nitroso-body. The authors have also investigated the nitro-bodies formed from isobutyl-phenol.

Dr. JAPP suggested that the propyl group, which was displaced by NO_2 , might be eliminated as propylene, which was then polymerised by sulphuric acid.

The SECRETARY then read a paper entitled "*Chemico-Microscopical Researches on the Cell-contents of certain Plants*," by A. B. GRIFFITHS. The author has contrasted the growth of some savoy cabbages grown in a soil to which no iron was added with that of plants grown with

the addition of ferrous sulphate. The weight of the latter plants was about twice that of the former; the ash contained notable quantities of iron; in one case the stalk contained 3.521 per cent Fe_2O_3 , and the leaves 12.29 per cent Fe_2O_3 . Microscopical sections of the leaves exhibited minute crystals in some of the cells. On running potassium ferricyanide under the cover glass these crystals became blue, and after the addition of barium chloride a cloudiness was observed; the crystals also were monoclinic, so the author concludes that they were crystals of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

The following communication was read by the SECRETARY:—"The Phenates of Amido-Bases," by R. S. DALE and C. SCHORLEMMER. The author could not isolate any compounds intermediate between aurin and para-rosanilin, and have concluded, after many experiments, that when aurin is heated with aqueous or alcoholic ammonia, the action proceeds at once to the formation of rosanilin. When equal molecules of aurin and common rosanilin were heated with alcohol, a solution was soon formed, and on concentration a crystalline powder with dark green lustre separated, which proved to be rosanilin aurinate. Similarly, when equal molecules of aniline and phenol were heated for some hours to the boiling-point, aniline phenate, $\text{C}_6\text{H}_7\text{N}, \text{C}_6\text{H}_6\text{O}$, was obtained in glistening plates, melting at 29.5° , boiling at 184.5° ; this substance has a faint phenol-like odour. A rosanilin phenate has been prepared by Mr. G. Dyson. Red alkaline solutions of aurin sometimes turn brown. On acidifying such a brown solution, a smeary mass is precipitated, from which a body was isolated in colourless crystals; it proved to be dioxy-phenyl-ketone, $\text{CO}(\text{C}_6\text{H}_4\text{OH})_2$.

The Society then adjourned to March 15.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, March 5, 1883.

GEORGE BUSK, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

THE Earl of Dalhousie, K.T.; James D. Bradshaw, M.A.; F. Werneck T. de Castro; Mrs. Elizabeth Dobson; Bryan Donkin, jun.; Miss Clara Gisborne; William Gonne; Major William Hammer; Walter Harris; Sir Charles Brodie Locock, Bart.; George Henry Pinckard; and Charles Richardson were elected Members of the Royal Institution. Two candidates for membership were proposed for election.

The following arrangements for the Lectures after Easter were announced:—

Prof. John G. McKendrick, M.D., F.R.S.E., Fullerian Professor of Physiology, R.I.—Ten Lectures on "Physiological Discovery: A Retrospect, Historical, Biographical, and Critical;" on Tuesdays, April 3, 10, 17, 24; Monday, April 30; Tuesdays, May 8, 15, 22, 29, and June 5.

Dr. Waldstein, Hon. M.A. Cantab.—Three Lectures on the "Art of Pheidias;" on Thursdays, April 5, 12, 19.

Prof. Tyndall, D.C.L., F.R.S.—Three or four Lectures; on Thursdays, April 26, and May 3, 10, 17.

Reginald Stuart Poole.—Three Lectures on "Recent Discoveries in (1) Egypt, (2) Chaldæa and Assyria, (3) Cyprus and Asia Minor;" on Thursdays, May 24, 31, and June 7.

Archibald Geikie, LL.D., F.R.S.—Six Lectures on "Geographical Evolution;" on Saturdays, April 7, 14, 21, 28, and May 5, 12.

Prof. C. F. Turner, of the University of St. Petersburg.—Four Lectures. "Historical Sketches of Russian Social Life;" on Saturdays, May 19, 26, and June 2, 9.

The presents received since the last Meeting were laid on the table, and the thanks of the Members returned for the same.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 9, 1883.

H. E. Roscoe, Ph.D., LL.D., F.R.S., &c., President, in the Chair.

DR. JOULE said that he had, in December, 1882, made a fresh determination of the freezing-point in a sensitive thermometer constructed thirty-nine years ago. During that time the point had risen about 1°F. , and although now rising very slowly, was not even yet quite stationary, having risen 1.40th of a degree Fahrenheit since November, 1879.

Ordinary Meeting, January 23, 1883.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., Vice-President, in the Chair.

"Remarks on the Simultaneous Variations of the Barometer recorded by the Late John Allan Brown," by Prof. BALFOUR STEWART, F.R.S.

Ordinary Meeting, February 6, 1883.

Prof. BALFOUR STEWART, LL.D., F.R.S., in the Chair.

"Note on the Vapours of Incandescent Solids," by HENRY WILDE.

It is generally admitted that the phenomena known as Moser's spectral images, which make their appearance on polished metallic surfaces when bodies are placed very close thereto, are attributable to the general property which solid bodies possess of giving off vapours of their own substance at common temperatures, and the peculiar odours emitted by some of the less volatile metals, such as copper, when subjected to friction or to the action of cutting tools, are also assignable to the like cause.

The production of Moser's images, as has been shown, is greatly assisted by the application of heat, and it might have been anticipated that at high temperatures the most dense and refractory substances would vapourise while retaining their solid form.

The conditions necessary for observing the behaviour of solids at high temperatures are well brought about in the modern form of incandescent electric lamp. This lamp consists of a bulb of glass from which the air is exhausted to the highest degree attainable, and a filament of metal or carbon is mounted in the bulb, and rendered incandescent by the action of the electric current.

Platinum, from its high degree of infusibility, was considered by some the most suitable substance for the luminous filament, and great expectations were formed, that by its use the problem of incandescent lighting would be solved. It was, however, found that an atmosphere of platinum vapour was formed in the interior of the bulb, which, after the lamp had been in action a lengthened number of hours, condensed on the surface of the glass and formed a bright reflecting surface like a mirror.

This property of the platinum, while affording a remarkable illustration of the vapourisation of a dense body while retaining its solid form, was fatal to its use as an illuminant, as the density of the film of platinum on the surface of the glass ultimately obstructed the greater portion of the light from the filament itself.

Chemists, I believe, are not unanimous in opinion as to whether elementary carbon ever passes from the solid to the liquid form.

Some years ago, I frequently made the experiment of concentrating upon a small pencil of carbon, 2 inches long and 3-20ths of an inch in diameter, an amount of

electric force sufficient to fuse a rod of platinum 2 feet long and $\frac{1}{4}$ of an inch in diameter.

The light from the pencil was of intense whiteness, but the carbon showed no signs of fusion, and rapidly diminished in thickness by combination with the oxygen of the air.

The substitution of a filament of carbon for platinum has now placed the incandescent electric light in the rank of recognised illuminants, and when not raised to too high a temperature the carbon filament is very durable. When, however, a high degree of incandescence is attained, an atmosphere of carbon vapour is formed in the interior of the bulb which condenses on the glass and forms a dark lustrous surface which obstructs the light in the same manner as when a filament of platinum was employed.

The behaviour of the carbon and the platinum in each of these lamps clearly shows that the most dense and refractory substances in nature vapourise at high temperatures while still retaining their solid form.

Electric lamps were exhibited by Mr. Wilde showing the condensed platinum and carbon on the interior surfaces of the glass bulbs.

CORRESPONDENCE.

A CORRECTION.

To the Editor of the Chemical News.

SIR,—In my letter on the solubility of ammonio-magnesian phosphate (CHEMICAL NEWS, vol. xlvii., p. 71), I notice a misprint at the end of the article. It should read:—

1000 c.c.	1 p.c.	ammonia water	dissolve	0.88 m.grm.	P_2O_5 .
1000	2	"	"	0.23	" "
1000	3	"	"	0.15	" "

The mistake is so flagrant that it would be noticed at once by anyone at all conversant with the determination of phosphoric acid; still, it is well to call attention to it.—I am, &c.,

THOMAS S. GLADDING.

55, Fulton Street, N.Y.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 5, January 29, 1883.

Contributions to the History of the Reactions between Sulphur, Carbon, their Oxides, and their Salts.—M. Berthelot.—The author has allowed these substances to act upon each other at a red heat, and observed the decompositions and combinations effected.

Determination of Phosphoric Acid in Arable Soils.—P. de Gasparin.—The author takes 20 grms. of the soil, finely powdered and sifted through silk, and attacks it in a porcelain capsule with hydrochloric acid diluted to one-fifth as long as there is effervescence. He then adds 80 c.c. of an *aqua regia* solution made up of 3 parts of hydrochloric to 1 part of nitric acid. He digests on the water-bath until the liquid takes a syrupy consistence, dilutes with cold distilled water, and washes on the filter with boiling water. The filtrate is then precipitated with caustic ammonia in excess. The precipitate, collected and dried, is ignited to cherry-redness in a platinum crucible, pulverised, re-dissolved in very dilute nitric acid (1-40th), and after digestion in the cold it is filtered. The

filtrate, freed by the preceding operations from lime, iron, and silica, contains the whole of the phosphoric acid. It is concentrated on the water-bath to bring it to a volume fit for the molybdic process. The phospho-molybdic precipitate, not being contaminated with a solution of salts of iron, aluminium, and calcium, and being absolutely free from silica, may after a single washing be re-dissolved in ammonia, and the phosphoric acid precipitated with magnesia mixture in the usual manner.

Reply to the Memoir of M. Marcel Deprez.—M. Maurice Lévy.—A continuation of the controversy on the Munich experiments.

Reply to the Observations Presented by M. M. Lévy in his Note of January 22, 1883.—MM. E. Mercadier and Veschy.—A discussion on the various systems of electric unities.

New Experiments on Electrolysis.—E. Semmola.—The author adapts to an ordinary voltameter the platinum electrodes, *a*, *b*, *c*, quite identical, and arranged triangularly at the bottom of the voltameter; one of the electrodes, *c*, is placed in connection with the positive pole of the battery, and the two others, *a* and *b*, communicate with the contacts of a commutator. The movable contact of this commutator is formed by a small metal bar in connection with the negative pole of the battery, and can either unite or separate the two electrodes, *a* and *b*, not connected with the battery. When the little bar disconnects these electrodes, the current of the battery passes directly from *c* to *b*, as in ordinary voltameters, and returns to the battery by the bar of the commutator. The electrode *a* being isolated from the circuit plays, then, no part. But when this bar is lowered upon the second contact of the commutator in connection with the electrode *a*, the current, on arriving at the first electrode, *c*, is bifurcated so as to regain simultaneously the two electrodes, *a* and *b*, and proceed thence to the battery. On measuring the quantity of hydrogen liberated under each of the jars corresponding to the two electrodes, *a* and *b*, their sum is found exactly equal to the quantity collected under *b* alone, when the entire current is passed through the electrode *b*.

Researches on the Passage of Alcoholic Liquids through Porous Bodies (Second Memoir).—H. Gal.—An alcoholic liquid, in contact with a membrane, in place of becoming concentrated, as Sœmmering stated, and as is generally taught, becomes weaker, as does also its vapour. This latter phenomenon, which may seem paradoxical, considering the difference of density of the vapours of alcohol and of water, is explained sufficiently if we remember the considerable difference existing between the tensions of aqueous vapours and of alcoholic vapours at all temperatures, and if we keep in mind that in air, alcohol encounters a space containing not a trace of its own vapour, whilst water finds an atmosphere already more or less saturated.

Vapours of Carbamide.—M. Isambert.—The author has studied the compressibility of the vapour emitted by carbamide. They behave like a mixture of ammoniacal gas and carbonic acid.

Manganese Sulphite.—Alex. Gorgeu.—The author has obtained two sulphites containing respectively 1 and 3 mols. of water. They combine easily with the alkaline sulphites, forming crystalline double salts.

New Ammonio-Cobaltic Combinations.—M. Maquenne.—The author forces a current of ozonised oxygen through an ammoniacal solution of cobalt sulphate. The liquid becomes, first brown, and then green, and a green salt is deposited on the sides of the tube in prismatic tables, or, if cobalt chloride has been used instead of the sulphate, in fine needles. These compounds are probably acid salts of Fremy's oxy-cobaltia.

Mutual Displacements of Bases in Neutral Salts, the Systems remaining Homogeneous (Second Memoir).—N. Menshutkine.—This paper will appear in full

Crystalline Form, Specific Heat, and Atomicity of Thorium.—L. F. Nilson.—Will be inserted in full.

No. 6, February 5, 1883.

Certain Combinations of Manganese Sulphite with Alkaline Sulphites.—A. Gorgeu.—The author has examined the potassium-manganese, ammonium-manganese, and sodium-manganese double sulphites.

Hydraulic Silica: a Reply to M. Le Chatelier.—Ed. Landrin.—A prolonged discussion on priority.

Mutual Displacements of the Bases in Neutral Salts, the Systems remaining Homogeneous (Third Memoir).—N. Menshutkin.—This memoir will be inserted in full.

Journal für Praktische Chemie.

New Series, Vol. xxvi, Part 8, No. 19, 1882.

Cyanæthine, and New Basic Derivatives (Second Memoir).—Ernst von Meyer.—By heating cyanæthine with hydrochloric acid, one of its atoms of nitrogen is replaced by hydroxyl, forming an *oxy-base*. Both this base and cyanæthine itself may be regarded as derivatives of cyanconine. The author describes this body; the behaviour of cyanæthine with nitrous acid, with methyl-iodide, the action of iodalkylene and ethylene bromide upon the oxy-base; the action of bromine upon cyanæthine, mono-bromo-cyanæthine, iso-adipic acid, and the behaviour of the oxy-base with bromine and potassa.

Trimethylene.—Aug. Freund.—The author endeavours to obtain an isomer of propylene by the action of sodium upon trimethylene bromide. He obtained a gas not identical with ordinary propylene, though having the same composition, C_3H_6 .

Ethylen-chlor-bromide and the Derivatives of Ethylen-chlor-sulpho-cyanide.—Dr. J. W. James.—The author describes the method of preparing ethylen-chlor-bromide adopted by Maxwell Simpson, the action of sodium sulphite upon ethylene-chloro-sulpho-cyanide, the formation of sulpho-cyan-ethyl-sulphonic acid, and the salts of β -chlor-ethyl-sulphonic acid.

Preliminary Communication.—Dr. W. Ostwald.—Induced by the papers of Menshutkin and L. Meyer contained in the last number of the *Berlin Berichte*, on the formation and decomposition of the amides or anilides, I am compelled to mention that I have been working for half a year on the action of acids upon amides, and especially upon acetamide. There is formed during this reaction, an ammoniacal salt; the rate of the transformation depends upon the nature of the acid, and is in a very simple relation to the magnitude, which I have called the "relative affinity," being approximately proportional to its square. The analytical method for determining the ammoniacal salt along with the undecomposed amide consists in treatment with sodium hypobromite in the azotometer, whereby the amide undergoes no change, whilst the nitrogen of the ammonia is at once liberated. In this manner I have succeeded in a measurement of the magnitudes of affinity by the corresponding speeds, whilst the methods hitherto employed assume a chemical equilibrium, i.e., a speed = 0. Here appear the rudiments of chemical dynamics in conjunction with the statical phase of the science, which has hitherto been exclusively cultivated.

Zeitschrift für Analytische Chemie.

Vol. xxi., Part 4, 1882.

Determination of Oxygen in Iron.—A. Ledebur.—This paper requires the accompanying diagram.

Lead in Samples of Tin.—M. Roux.—From the *Bulletin de la Soc. Chimique*.

Determination of Sugar in Separation Mud.—A. Nord.—Instructions for the complete extraction of the sample.

Determination of Chloric Acid in Bleaching Lime.—E. Dreyfuss.—From the *Bulletin de la Soc. Chimique*.

Determination of Sugar in Calcium Saccharate.—K. Stammer.—The author grinds up the sample with water to a homogeneous paste, adds rosolic acid as indicator, and drops in glacial acetic acid until the solution is faintly acid. It is then so colourless that it can be examined with the polariscope. The proportion of lime is ascertained alkalimetrically with normal nitric acid.

Comparison of the Value of Extracts of Logwood.—M. Reinhard.—The author determines the proportions soluble respectively in water, in ether (hæmatoxyline), and in alcohol (hæmatine). It is mentioned that Sanford's extract contains 3 per cent less hæmatoxyline, 10 per cent less hæmateine, 7 per cent more insoluble residue, and 5 per cent more water, than the French extract.

Adulteration of Logwood-Extract with Treacle, Glucose, &c.—E. Lauber adds yeast to the solution, and, after the fermentation is over, determines the alcohol.

Detection of Adulteration of Orchil with Aniline-red.—G. Heppe adds to the aqueous solution picric acid, which throws down aniline-red and violet, but does not precipitate pure extract of orchil. If the precipitate is very slight it does not subside for some days, but it gives the liquid a brown turbidity when examined by reflected light.

Use of Citric Acid in the Analysis of Phosphates.—A. Grupe, A. von Ollech, and B. Tollens.—This memoir is merely mentioned.

Determination of Protein Compounds.—A. Stutzer.—One gramme of the substance is comminuted, sifted through a fine sieve, placed in a beaker with a mixture of 1 c.c. acetic acid and 100 c.c. alcohol, heated to a boil, and when cold decanted through a smooth filter, so that little or none of the insoluble matter may come upon the filter, which is then repeatedly washed with warm alcohol to remove acetic acid and dissolved fat, and set aside. The residue in the glass is covered with 100 c.c. of water, heated to a boil, mixed when half cold with 0.3 to 0.4 gm. hydrated copper oxide, filtered through the former filter, and washed. All the non-proteinic nitrogenous matter passes into solution. The precipitate is dried at 100° to 110°, and its nitrogen determined by combustion in the ordinary manner. The nitrogen in the non-proteinic compounds may be found by difference.

Quantitative Determination of the Albumenoids and of the Non-Albumenoid Nitrogen Compounds.—E. Schulze.

New Contributions to a Knowledge of the Nitrogenous Constituents of Potato Tubers.—E. Schulze and E. Eugster.

Determination of Woody Fibre.—C. Krauch and W. v. d. Becke.—The above three papers are merely mentioned.

Alkalies in Silver Nitrate.—Fr. Stolba dissolves the sample in a minimum of water, and adds to the clear solution hydro-fluosilicic acid. A turbidity or a precipitate shows the presence of alkalies.

Examination of Commercial Pancreatin.—D. C. Moriarta.—From *New Remedies*.

Determination of Morphine in Opium.—E. Mylius.—Into each of two test-tubes fitted with corks are put 5 drops of concentrated solution of iodic acid, then 5 c.c. of rectified carbon disulphide. Lastly, into one tube are put 10 c.c. of a solution of pure morphine, and into the other 10 c.c. of an extract of the sample. The tubes are corked, and both tubes are shaken up for exactly the same time, two to three minutes. The colours are then compared. If both are equal the opium contains 10 per cent morphia. If they are unequal, the more deeply coloured solution is let down with carbon disulphide till the colours are equal. The proportion of morphine is then deduced from the volume of the liquid, which is readily seen when graduated tubes are used. The solution of morphine

taken as a standard is made by dissolving 0.1 grm. morphine with 3 grms. dilute sulphuric acid in 100 c.c. water. For extracting the sample, 0.5 grm. in powder are boiled with 10 grms. water in a 50 c.c. flask, mixed with 3 grms. basic lead acetate, made up to 50 c.c. with cold water, well shaken up, filtered, and the entire filtrate precipitated with 15 drops sulphuric acid. The liquid is filtered again, and must be absolutely clear.

Examination of Benzoic Acid.—P. W. Bedford.—From the *Pharmaceutical Journal*.

Methods relating to Physiology and Pathology.—F. Hofmeister.

Determination of Urea with Sodium Hypobromite.—F. Hofmeister.—From the *Moniteur Scientifique*.

Detection of Sugar in Urine with Alkaline Solution of Copper.—Worm Müller.—The author recommends the following modified process:—5 c.c. of filtered urine, freed from albumen, are measured with a pipette, and heated to a boil in a test-tube. At the same time, a mixture of 1 to 1.5 c.c. of the copper solution and 2.5 c.c. of alkaline solution of salt of Seignette (potassium-sodium tartrate) is boiled. The boiling in both liquids is broken off at once, and after twenty to twenty-five seconds they are mixed together. Immediately after mixing the liquid generally appears of a blue-green, and the separation of cuprous oxide takes place at once, or within five to ten minutes. The cuprous oxide generally takes the form of a fine precipitate, which by reflected light appears as a greenish yellow turbidity. If no precipitate appears the test is repeated with increased quantities of the copper solution, 2, 2.5, 3 c.c. &c.

Metalbumen and Paralbumen.—O. Hammarsten.—The author has made an elaborate investigation of the fluids of a series of ovarian cysts, consisting chiefly of Scherer's metalbumen and paralbumen.

Methods relating to Chemical Jurisprudence..

Detection of Chloroform.—D. Vitali.—Pure hydrogen gas is passed through a retort, in which the substance in question is distilled. The hydrogen gas thus charged with chloroform is either examined for chlorine by combustion, or submitted to Hofmann's iso-nitril reaction, or passed through a freshly prepared mixture of thymol and solid potassa. If chloroform is present this mixture will be coloured a fine reddish violet.

The Ptomaines.—P. Brouardel and E. Boutmy.—From the *Comptes Rendus*.

Examination of Handwriting.—W. Thomsen.—From the *CHEMICAL NEWS*.

MEETINGS FOR THE WEEK.

SATURDAY, 11th.—Physical, 3. "On a Method of Measuring Electrical Resistances with a Constant Current," by Sheldford Bidwell. "On some Uses of a New Projection Lantern," by Mr. W. Lant Carpenter.

MONDAY, March 12.—London Institution, 5.
Medical, 8.30.

TUESDAY, 13th.—Royal Institution, 3. "The Supreme Discoveries in Astronomy (The Astronomical Significance of Heat)," by Professor R. S. Ball.

— Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8.30.
— Photographic, 8.

WEDNESDAY, 14th.—Society of Arts, 8.
— Microscopical, 8.

THURSDAY, 15th.—Royal Institution, 3. "The Spectroscope and its Applications," by Professor Dewar.

— London Institution, 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Chemical, 8. On some Condensation-Products of Aldehyds with Aceto-Acetic Ether and with Substituted Aceto-Acetic Ethers," by Mr. F. E. Matthews.

FRIDAY, 15th.—Royal Institution, 8. "Thoughts on Radiation, Theoretical and Practical," by Prof. Tyndall, at 9.

SATURDAY, 17th.—Royal Institution, 3. "Music as a Form of Artistic Expression," by Mr. H. H. Statham.

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ST. PAUL'S SCHOOL.—An Examination

for filling up about Six Vacancies on the Foundation will be
held on the 10th April, 1883.—For information apply to the Clerk to
the Governors, Mercers' Hall, E.C., or to the School Secretary
St. Paul's Churchyard, E.C.

FOR SALE.—A Complete Set of the Caven-

dish Society's Publications: comprising Gmelin's Handbook
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NOTES ON THE ABSORPTION OF ULTRA-VIOLET RAYS BY VARIOUS SUBSTANCES.*

By GEORGE D. LIVEING, F.R.S., Professor of Chemistry, and
J. DEWAR, M.A., F.R.S., Jacksonian Professor,
University of Cambridge.

THE following notes contain some records of ultra-violet absorptions in addition to those which have been examined by Soret, Hartley, M. de Chaudonnet, and other investigators. For these observations we have generally used the spark of an induction coil, with Leyden jar, between iron electrodes as the source of light. Occasionally we have used other electrodes, but the lines of iron are so multitudinous, and so closely set in a large part of the ultra-violet region of the spectrum, that they form almost a continuous spectrum, at the same time there are amongst them a sufficient number of breaks and conspicuous lines to serve as points of reference. The spectroscopist has a single prism of quartz, and the telescopes have quartz lenses. The image of the spark was projected on to the slit of the spectroscopist by a quartz lens, and the absorbent substances were interposed between the slit and the last-mentioned lens. The gases were held in tubes fitted, some with quartz, others with rock salt, plates on the ends; liquids in cells with quartz sides. The spectra were all photographed.

Chlorine in small quantity shows a single absorption band extending from about N (3580) to T (3020). As the quantity of chlorine is increased this band widens, expanding on both sides, but rather more rapidly on the less refrangible side. Different quantities of chlorine produced absorption from about H (3968) to wave-length 2755, from wave-length 4415 to 2665, and from wave-length 4650 to 2630. With the greatest quantity of chlorine tried the absorption did not extend above wave-length 2550.

Bromine vapour in small quantity absorbs light up to about L (3820), and is quite transparent above that. With larger quantity the absorption increases, gradually extending with increase of bromine vapour from L to P (3360); and at the same time there is a gradually increasing general absorption at the most refrangible end of the spectrum, beginning at about wave-length 2500; so that the denser bromine vapour is transparent for a band between wave-length 2500 and 3350.

Liquid bromine in very thin film between two quartz plates is transparent for a band between wave-length about 3650 and 3400, shading away on both sides, so that below M on one side and above P on the other the absorption seems complete. The transparency of the liquid film ends on the more refrangible side just where that of the vapour begins.

Iodine vapour tolerably dense cuts off all within the range of our photographs below wave-length 4300, and its absorption gradually diminishes from that point up to about wave-length 4080, from that point it is transparent. Denser vapour produces complete absorption up to 4080 and partial absorption above that point.

Iodine dissolved in carbon disulphide is transparent for a band between G and H, cutting off all above and below. It is not possible to tell how much of the light above M (3727) is absorbed by iodine in such a solution, inasmuch as carbon disulphide is opaque for rays more refrangible than M.

Iodine dissolved in carbon tetrachloride when the solution is weak, shows only the absorption due to the solvent

described below. More iodine increases the absorption until it is complete above P (3360), with shading edge as far down as about wave-length 3400.

Sulphurous acid gas produces an absorption-band which is very marked between R (3179) and wave-length 2630, and a fainter absorption extending on the less refrangible side to O (3440), and on the other side to the end of the range photographed, wave-length 2300.

Sulphuretted hydrogen produces complete absorption above wave-length 2580. Below that a partial general absorption.

Vapour of carbon disulphide in very small quantity produces an absorption-band extending from P to T, shading away at each end; no absorption in the higher region. With more vapour the absorption-band widens, extending from about wave-length 3400 to 3000, and a second absorption occurs beginning at about wave-length 2580, and extending to the end of the range photographed.

Carbon tetrachloride liquid produces an absorption-band with a maximum about R, extending, but with decreasing intensity, up to Q (3285) on one side, and to s (3045) on the other. In the higher region there is a second absorption sensible about wave-length 2600, and increasing in intensity up to about wave-length 2580, beyond which point it is complete.

Chlorine peroxide gives a succession of nine shaded bands, at nearly equal intervals, between M and S, with faint indications of others beyond. In the highest region this gas seems quite transparent.

A slice of chrome-alum a quarter of an inch thick, is transparent between wave-lengths 3270 and 2830, its absorption gradually increases on both sides of those limits, but rather more rapidly on the more refrangible side than on the other, and becomes complete below about wave-length 3360 and above wave-length 2730.

A very thin plate of mica shows absorption beginning about S (3100), rapidly increasing above U (2947), and complete above wave-length 2840.

A thin film of silver precipitated chemically on a plate of quartz transmits well a band of light between wave-length about 3350 and 3070, but is quite opaque beyond those limits on both sides.

A thin film of gold similarly precipitated merely produces a slight general absorption all along the spectrum.

The difference between the limits of transparency of Iceland spar for the ordinary and extraordinary rays we find to be very small, and hardly to be detected without using a considerable thickness, three inches or more, of the spar.

We had expected to be able to apply the well-known photometric method by means of polarised light to the comparison of intensities of ultra-violet rays. Ordinary Nicol's prisms are not applicable to ultra-violet rays on account of the opacity of the Canada balsam, with which they are cemented, but through the kindness of the President of the Society, we obtained from him the loan of a pair of Foucault's prisms. Upon taking photographs of the spectrum of the iron spark through this pair of prisms at various inclinations between the planes of polarisation of the two prisms, we found that for the whole range between the position of parallelism and the inclination of 80° there was no sensible difference of effect upon the photographic plate, though the length of exposure was in all cases the same. For inclinations between 80° and 90° there was a sensible and increasing diminution in the photographic effect as the planes of polarisation of the polariser and analyser were more nearly at right angles to one another. It seems to follow from this that the full photographic effect ensues when the intensity of the light reaches a certain limit, but that for intensities of light beyond that limit there is no sensible increase in the effect until the stage of solarisation is reached.

Benzoyl Mesitylene.—E. Louise.—This compound has the composition $C_{16}H_{16}O$.—*Comptes Rendus*.

* A Paper read before the Royal Society, March 8, 1883.

NOTE ON THE
REVERSAL OF HYDROGEN LINES;
AND ON THE OUTBURST OF HYDROGEN LINES
WHEN WATER IS DROPPED INTO THE ARC.*

By G. D. LIVEING, M.A., F.R.S., Professor of Chemistry,
and J. DEWAR, M.A., F.R.S., Jacksonian Professor,
University of Cambridge.

THE concentration of the radiation of hydrogen in a small number of spectral lines would lead us to expect that the absorption of light of the same refrangibility as those lines would, at the temperature of incandescence, be correspondingly strong, and that therefore the hydrogen lines would be easily reversed. The mass of hydrogen which we can raise to a temperature high enough to show the lines is, however, so small, that notwithstanding the great absorptive power of hydrogen for the rays which it emits, the reversal of the lines has not hitherto been noticed. We find, in fact, that the lines are very readily reversed, and the reversal may be easily observed.

When a short induction spark is taken between electrodes of aluminium or magnesium in hydrogen at atmospheric pressure, a large Leyden jar being connected with the secondary wire of the coil, the hydrogen lines show no reversal; but if the pressure of the hydrogen be increased by half an atmosphere, or even less, the lines expand and a fine dark line may be seen in the middle of the F line. As the pressure is increased this dark line becomes stronger, so that at two atmospheres it is very decided. As the F line expands with increase of pressure the dark line expands too and becomes a band. It is best seen when the pressure is between two and three atmospheres. When the pressure is further increased the dark band becomes diffuse, and at five atmospheres cannot be distinctly traced. No definite reversal of the C line was observed under these circumstances. The dispersion used, however, was only that of one prism.

By using a higher dispersion the reversal of both the C and F lines may be observed at lower pressures. For this purpose we have used a Plücker tube, filled with hydrogen and only exhausted until the spark would pass readily when a large jar was used.

The light of the narrow part of the tube is, under these circumstances, very brilliant, while the spark in the broad ends is wider and less bright, but does not fill the tube. On viewing such a tube end on, and projecting the image of the narrow part of the tube on to the slit of the spectroscope, a continuous spectrum, of the width of the image of the narrow part of the tube, is seen, besides the lines of hydrogen given by the discharge in the wide part of the tube. These lines extend above and below the narrow continuous spectrum if the electrode is well placed, so that half an inch or so of the spark in the wide part of the tube may intervene between the narrow part of the tube and the spectroscope. The continuous spectrum of the narrow part of the tube seems due chiefly to the expansion of the hydrogen lines when the discharge occurs in so confined a space, and it is much brighter than the lines given by the spark in the wide part of the tube. Where the latter cross the continuous spectrum a very evident absorption occurs. We have observed it with a diffraction grating. The C line in the third order falls so near the F line in the fourth that both may be observed together. F is much more expanded than C, and the reversal consequently less marked, though quite plain. The other lines being still more diffuse their absorption could not be traced.

We have before observed (*Proc. Roy. Soc.*, vol. 30, p. 157) that the C and F lines of hydrogen are visible in the arc of a De Meritens magneto-electric machine taken in hydrogen; though in the arc of a Siemens machine the C line can only be detected at the instant of breaking the

arc, the F line hardly at all. When, instead of taking the arc in hydrogen, small drops of water are allowed to fall from a fine pipette into the arc taken in air in a lime crucible, each drop as it falls into the air produces an explosive outburst of the hydrogen lines. Generally the outburst is only momentary, but occasionally a sort of flickering arc is maintained for a second or two, and the hydrogen line C is visible all the time. The lines (C and F) are usually much expanded, but are frequently very unequally wide in different parts of the line. F is weaker, more diffuse, and more difficult to see than C, and is visible for a shorter time. There is no sign of reversal. In the explosive character of the outburst, and the irregularity in the width of the lines, the effect resembles that of an outburst of hydrogen in the solar atmosphere. The elements of the water are, as we must suppose, separated in the arc, but from the explosive character of the effect they are not uniformly distributed in the arc. The arc being horizontal, and the image of it projected on to the slit of the spectroscope, it was really a very small section of the arc which was under observation, and this renders the variation in the width of the lines the more remarkable.

ON THE DIFFUSION OF GASES.

By K. WAITZ.

THE author's results may be thus summed up:—The coefficient of diffusion for the free diffusion of two gases into each other is no constant magnitude. After the commencement of diffusion it decreases with time in any given section of the containing vessel, and soon reaches a limit of value which is constant for every section. The change of these limits of value from one section to another ensues proportionally to the distance of such sections from the free surface of the diffusion-vessel.—*Wiedemann's Annalen*, 1882, p. 201.

ON THE
CRYSTALLINE FORM, THE SPECIFIC HEAT,
AND THE ATOMICITY OF THORIUM.

M. L. F. NILSON.

IN a former memoir I have described the principal properties of metallic thorium as prepared in a crucible of soft iron by the action of sodium upon the potassium-thorium chloride. The microscope shows minute slender laminae, of a silvery lustre, mixed with the greyish powder of the metal, and consisting of a multitude of small tables of a hexagonal aspect. M. Brögger, after a very minute examination, has succeeded in showing that they form a regular combination between the octahedron and the tetrahedron—a fact the more interesting, as silicon crystallises in the same form, and that a remarkable analogy thus exists between these two elements.

The density of the metal found in the upper parts of the cavity of the crucible, and which on oxidation absorbs 11.1 per cent of oxygen was = 10.7824; that of the metal enclosed in the melted sodium chloride in the lower part of the crucible = 11.00. I supposed then that the lower density of the kind first mentioned was due to thoria mixed with it, the density of the latter being = 10.22; or, secondly, that the metal of the latter was almost pure. But the two specimens were found to have an almost identical composition. Hence it is clear that the difference of densities depends merely on the more definite crystallisation of the brighter metal of 11.00. The density of pure metallic thorium = 11.230 for the bright and 10.968 for the dull variety. It follows, therefore, that the atomic volume of thorium = 20.94, a value which approaches that of zirconium, cerium, lanthanum, and didymium, and that the

* A Paper read before the Royal Society, March 8, 1883.

atomic heat of oxygen in thoria (thorium oxide) = 4.08, almost the same value as in zirconium, silicium, ceric, titanous, stannous, and manganous oxides.

I have determined the specific heat of thorium with the ice-calorimeter, using 3.1752 grms. of the metal of the density 11.000, enclosed in a small glass capsule weighing 0.7151 grm. After being heated for an hour by steam to the temperature T, as determined by a Geissler thermometer, and perfectly in harmony with the pressure B, the capsule was thrown into the calorimeter, and when cooled down to 0° produced changes on the position of the mercurial thread upon its scale in millimetres M. (The author gives a table of the heats, pressures, and thermometric changes noted in his experiments.)

The specific heat of the glass employed having been determined as 0.1989, and that of pure thoria as 0.0548, whilst the metal operated upon consisted of 0.0266 Fe, 0.6303 ThO₂, and 2.5183 Th. Hence it was calculated that this quantity of pure thorium, if cooled from 100° to 0° would disengage 6.942 cal., its specific heat being 0.02757. If we apply the law of Dulong and Petit to the specific heat found, we may evidently conclude that thorium is quadrivalent, for the mean value of the atomic heat of Th = 232.4, calculated according to the law, is 6.38, the experimental mean being 6.41. Hence it is proved that thorium, with its sole oxide ThO₂, finds its true place among the quadrivalent elements.—*Comptes Rendus*, xcvi., p. 346.

STEEL CASTINGS.

By SERGIUS KERN, M.E., St. Petersburg.

THE process of manufacturing steel castings is very carefully kept secret at all works engaged in such a business. We have had several interesting papers by M. Pourcel, of Terrenoire, France, but he gives nearly nothing about the *modus operandi*. We understand well that a man is not expected to say everything about his method if it brings him £ s. d. In Russia, very few steel castings were made at some works, and these may be called only experimental. We have lately received some information of a process of moulding for steel casting, the invention of Mr. George Cowing (*Journal of the Iron and Steel Institute*, No. 2, 1882, p. 731). Quartz from Finland (a very pure specimen) was calcined, ground to a rather fine powder, and mixed with from 2 to 3 per cent of glue water and flour. This was used for moulding.

As a facing fine quartz powder, with a small quantity of graphite well mixed with water, was used. The steel was prepared as follows:—80 lbs. of good iron, containing about 0.10 per cent of carbon,* was melted in a crucible; and were next added—2 lbs. of silicon pig-iron, containing 6.5 per cent of silicon, and 0.5 lb. of ferro-manganese, containing 75 per cent of manganese. The metal was kept in the furnace, with the alloy, for about fifteen minutes, and it was next poured into the moulds. The castings had a very clean surface, and were good.

My opinion is, that the clean surface depends much upon the moulding material. There is certainly a reaction between the silica and the gases. Secondly, as the quartz expands by heat, it gives a free passage to gases, and at the same time compresses the casting.

Certain Vegetable Poisons.—A. Bassiner. — The author has studied the so-called oil of *Ranunculus sceleratus*, anemone (from *Anemone pulsatilla*), and cardol (from *Anacardium orientale*). All these poisons are destroyed by the action of potassa, so that they cannot occasion mistakes when searching for cantharidine by Radecki's process.—*Zeitschrift*.

* We propose to use soft basic steel.

ON THE USE OF LITMUS, METHYL-ORANGE, PHENACETOLIN, AND PHENOL-PHTHALEIN AS INDICATORS.*

By ROBERT T. THOMSON.

THE number of indicators which have been proposed to supersede litmus is now very great, but none, so far as I am aware, have been thoroughly tested as regards their efficiency in presence of the impurities which constantly occur in the alkaline hydrates and carbonates of commerce. There is no lack of information to be obtained concerning the high tinctorial power of these indicators compared with that of litmus, and their delicacy when employed in the determination of alkalis in solutions of the pure hydrates and carbonates. But on the question of their value in presence of sulphites, thiosulphates, sulphides, phosphates, silicates, aluminates, &c., little or no attention has been bestowed.

In the following paper are detailed the results of a series of experiments I carried out with a view of testing, in as complete a manner as possible, the merits of litmus, methyl-orange, phenacetolin, and phenol-phthalein as indicators in the estimation of alkalis and certain free acids. Instead of taking these indicators in succession, and recording all the tests made with them, I have considered it preferable to take the substances which were tested by the standard acid or alkali, and state the results obtained with each indicator. By this means a close comparison of the behaviour of the different indicators with the same substance will be secured.

The tests were made in such a way that the solution employed would measure about 100 c.c. when the end-reaction was observed. The strengths of the indicator solutions (0.5 c.c. of which was used for every experiment) were so arranged that equal volumes of each gave, as nearly as could be judged from their different tints, the same intensity of colour at the point at which the change caused by the addition of excess of acid or alkali was just complete.

I. Delicacy of the Indicators in Absence of Interfering Agents.

This was tested by adding the 0.5 c.c. of the indicator solution to 100 c.c. of distilled water, and finding how much decinormal acid or alkali (1 c.c. = 0.0031 grm. Na₂O, or 0.004 grm. SO₃) was required to change the colour.

Litmus.—This indicator, as is well known, is naturally blue, and remains so in presence of alkalis and alkaline carbonates, but changes to red when a slight excess of acid is added. The litmus solution employed contained 20 grms. of the dry extract per litre. Half a c.c. of this was mixed with 100 c.c. of distilled water, and decinormal sulphuric acid added from a burette, drop by drop, till no further alteration in colour was observed. To accomplish this 0.5 c.c. of the acid was consumed. This is equal to 0.05 c.c. (about one drop) of normal acid, which is the strength usually employed in alkalimetric tests.

Methyl-orange.—This substance is soluble in water with formation of an orange-yellow liquid, which is unchanged in colour by alkalis or alkaline carbonates and bicarbonates, but is transformed to a deep pink by a mineral acid. The solution employed contained 0.15 grm. of the methyl-orange per litre, and 0.5 c.c. of decinormal acid was required to effect a complete change in the colour when tested in exactly the same way as the litmus solution. It is thus on an equality with litmus as regards delicacy in absence of all salts.

Phenacetolin.—This substance is soluble in alcohol with formation of a dark brown liquid, which gives, with the

* A Paper read before the Philosophical Society of Glasgow (Chemical Section), January 22, 1883.

hydrates of potassium and sodium, even in presence of carbonate, a scarcely perceptible yellow; with ammonia and the normal alkaline carbonates, a dark pink; with the bicarbonates, a much more intense pink than with the normal carbonates; and with mineral acids, a golden yellow colour. The solution employed contained 2 grms. of phenacetolin per litre, and was tested by decinormal carbonate of sodium, of which 0.1 c.c. was required to produce a decided change from a faint brown tinge to a dark pink.

Phenol-phthalein.—This indicator gives rise to a fine red colour in presence of alkaline hydrates and carbonates, but with bicarbonates (in absence of normal carbonates) and free acids no colour is produced. Phenol-phthalein is almost insoluble in water, but is readily soluble in 50 per cent alcohol. The solution used contained 0.5 gm. per litre, and was of a pale yellow colour, which was probably due to a slight impurity. When tested under the conditions observed in the case of the other indicators, 0.1 c.c. of decinormal hydrate of sodium caused a sudden transformation, the colourless solution becoming red. In the following table (I.) will be found a summary of the results given above:—

TABLE I.

Showing the delicacy of the indicators in the absence of interfering agents.

Amount of distilled water used for each test		100 c.c.
,, indicator solution ,,		0.5 ,,
Name of Indicator.	Grms. of Solid Matter per Litre of Indicator Solution.	Amount of Decinormal Acid or Alkali required to change Colour of Indicator.
Litmus	20.0	0.5 c.c. H_2SO_4
Methyl-orange ..	0.15	0.5 ,, "
Phenacetolin ..	2.0	0.1 ,, Na_2CO_3
Phenol-phthalein	0.5	0.1 ,, NaHO

II. Application of the Indicators to the Determination of Soda existing as Hydrate, with a Small Proportion of Carbonate.

The solution of caustic soda employed was of normal strength, and each test was made with 50 c.c., which thus contained 1.55 grms. of available soda. The soda existing as carbonate in this quantity was 0.024 gm., and was estimated by precipitation with chloride of barium.

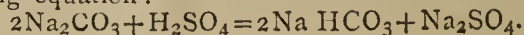
Litmus.—When this indicator was used, exactly 50 c.c. of normal sulphuric acid were consumed. The solution was, of course, boiled thoroughly after each addition of acid, especially when near the neutral point, and only a single drop was required to effect the end-reaction.

Methyl-orange.—The great advantage claimed for methyl-orange over litmus is that with the former no boiling is required, as carbonic acid has no effect on the colour. On making several determinations of soda with this indicator, I found that its delicacy was by some means considerably impaired, as the pale yellow colour became just perceptibly tinged with pink when 49.95 c.c. of the normal acid were added. The change in colour was very decided when 50, but was not fully developed till 50.15 c.c. were consumed. In these cases 0.2 c.c. of the acid was necessary to bring out the full intensity of colour, while 0.05 c.c. produced the same result in absence of interfering agents. It would be naturally expected that if half the quantity of methyl-orange were used a proportionately more delicate end-reaction would be secured, but at least 0.15 c.c. of the normal acid was required to occasion the alteration in tint. Again, the same expectation might reasonably be entertained with regard to varying the proportions of soda, but I found that when 0.775 gm. of soda was tested 0.15 c.c., while with 3.1 grms. of soda 0.25 c.c., of the test acid was indispensable in effecting the complete transformation. It is evident that this extension of the end-reaction over from 0.15 to 0.25 c.c. of normal acid must be due, either to the liberated carbonic acid, or to the salt of sodium pro-

duced by the action of the acid on the hydrate and carbonate of sodium. That it is solely owing to the latter cause I shall show when the action of the neutral sulphates, chlorides, and nitrates of the alkalies is under consideration. On looking over these results the question arises,—At what point is the estimation of alkali, when methyl-orange is used as indicator, to be reckoned as finished? The point I have adopted is that at which the first decided change in colour is apparent, and this end-reaction coincides exactly with that of litmus. The intensification of the colour by the further addition of acid serves as a confirmation of the first reading. Greville Williams, in a paper which appeared in the *CHEMICAL NEWS*, vol. xxxix., p. 98, recommends for each determination the use of from 0.1 to 0.2 c.c. of a solution containing 0.1 gm. of methyl-orange per litre. The larger of these quantities is about one-fourth of that which I have employed, and when excess of acid is added gives a very faint pink colour, which is sensibly less intense in presence of much sulphate of sodium. It is obvious, however, that the amount of the indicator solution used must be varied according to the volume and colour (if any) of the solution in which the alkali is to be determined.

Phenacetolin.—This indicator was introduced by Degener for use in the determination of the respective proportions of hydrate and carbonate of sodium in the same solution, and was tested by Prof. Lunge, whose results will be found in the *Journ. Soc. Chem. Industry*, i., 55. To determine the hydrate of sodium the normal acid was added till the scarcely perceptible yellow colour gave place to a rose-pink, which remained permanent for a few minutes at least. Two tests gave respectively 49.1 and 49.2 c.c. of acid consumed, which are equal to 1.523 and 1.526 grms. of soda existing as hydrate, as against 1.526 obtained by deducting the soda existing as carbonate (which was determined by chloride of barium) from the total soda. It must be carefully borne in mind that the rose colour should be permanent, for it may be developed by adding a drop of the acid, even when there is still a little hydrate present, and then fade slowly away. The first reading can be confirmed by adding a drop or two more acid, which should render the colour more intense. To find the proportion of soda existing as carbonate, the addition of acid was now continued. The colour at first was intensified, then became mixed with yellow, and finally all the pink tinge was eliminated, and a golden yellow was produced. For each test 50 c.c. of the normal acid were consumed, thus giving, in the one case, 0.9 c.c. for the soda as carbonate, and in the other 0.8 c.c., showing respectively 0.027 and 0.024 gm. of soda existing as carbonate, as against 0.024 estimated by chloride of barium. A much sharper end-reaction is obtained by boiling off the carbonic acid after each addition of acid when determining the portion of soda existing as carbonate. Phenacetolin is not adapted to the estimation of small quantities of hydrate in presence of a large proportion of carbonate of sodium or potassium, as is evident from the following test:—To a solution containing 2.65 grms. of carbonate of sodium and 0.04 gm. of hydrate of sodium in 100 c.c., phenacetolin was added, but even after an hour had elapsed the dark pink colour did not disappear, as it should do if the process were of any value.

Phenol-phthalein.—This indicator, which seems first to have been employed by Luck in that capacity, can also be used for the determination of the proportion of hydrate and carbonate of sodium in the same sample. The method of procedure is to add the normal acid to the cold alkaline solution till the red colour is discharged, taking care, by using a dilute solution and keeping the point of the burette in the liquid, that no carbonic acid escapes. The point at which the colour is dispelled is when all the hydrate is neutralised, and the carbonate has been converted into bicarbonate according to the following equation:—



By this means the whole of the soda existing as hydrate and half the soda as carbonate is determined. The number of c.c. consumed is now noted, and the estimation continued, boiling thoroughly after each addition of acid to decompose the bicarbonate of sodium, and thus bring back the red colour. It is preferable, as pointed out by Warder in his paper in the *CHEMICAL NEWS*, vol. xliii, p. 228, to add excess of normal acid, boil off the carbonic acid, and titrate back with normal caustic soda. The results of several experiments gave 49.6 c.c. of normal acid consumed for the hydrate and half the carbonate of sodium, and 50 c.c. for the total available soda, or, in other words, 0.8 c.c. for the carbonate and 49.2 for the hydrate. These results agree almost exactly with those obtained by the estimation of the carbonate of sodium by barium chloride, and with the use of phenacetolin as indicator. It must be noted that the more carbonate of sodium there is present, the less delicate will the end-reaction be, as the red colour gradually fades away during the first portion of the titration. It is also evident, from the nature of the process, that this method is quite unreliable for the determination of a small quantity of hydrate of sodium in presence of a large proportion of carbonate of sodium.

TABLE II.

Showing results obtained by each indicator when used in the determination of soda in caustic soda containing a little carbonate of sodium.

Soda, existing as hydrate, employed ..	1.526 grms.		
" " carbonate, " ..	0.024 "		
Total soda employed	1.550 "		
Name of Indicator.	Grms. of Total Na ₂ O found.	Grms. of Na ₂ O as Hydrate found.	Grms. of Na ₂ O as Carbonate found.
Litmus	1.55—1.55	—	—
Methyl-orange ..	1.55—1.55	—	—
Phenacetolin..	1.55—1.55	1.523—1.526	0.027—0.024
Phenol-phthalein—	1.55—1.55	1.526—1.526	0.024—0.024

III. Estimation of Available Potash in Caustic Potash.

It is quite unnecessary for me to give any details of the results of the experiments made under this head. Litmus and methyl-orange can be used for the determination of the total available potash and phenacetolin and phenol-phthalein for the estimation of the respective proportions of hydrate and carbonate of potassium, with as great accuracy as in the case of the caustic soda.

IV. Estimation of Ammonia existing as Hydrate.

The liquor ammonia used for the following tests did not contain an appreciable quality of carbonate, and was free from other impurities. It was diluted with an indefinite quantity of water, and 50 c.c. of the dilute sample were employed for each determination. This quantity, according to a result obtained by converting the ammonia into chloride of ammonium and drying at 100° C., contained 0.547 grm. of ammonia (NH₃).

When litmus, methyl-orange, or phenacetolin was used, exactly 32.4 c.c. of normal sulphuric acid was consumed, which are equal to 0.550 grm. of ammonia. The end-reactions in each case were quite as delicate as with caustic soda. As phenacetolin produces with ammonia the dark pink colour characteristic of its reaction with the carbonates of sodium and potassium, and not the faint yellow found with the hydrates of these metals, the respective proportions of hydrate and carbonate of ammonium cannot be determined by titration in presence of this indicator.

In the two determinations made with phenol-phthalein as indicator 31.5 c.c. and 31.4 c.c. of the normal acid were consumed. After 25 c.c. had been added the colour began to fade away slowly, and was fully discharged at the point mentioned. These results show respectively 0.535 and 0.533 grm. of ammonia, and are so far below the truth as to be equal to about 3 per cent of the whole ammonia

present. It is therefore perfectly plain that phenol-phthalein is utterly useless for indicating the end-reaction in the estimation of ammonia. This anomalous behaviour of phenol-phthalein is due to the action of the salt of ammonium which is formed, and which destroys the red colour produced by the ammonia when the proportion of the latter becomes small. That this is the true explanation will be shown when the effect of the neutral salts of ammonium on the indicators comes to be examined.

TABLE III.

Determination of Ammonia existing as Hydrate. Ammonia (NH₃) employed for each test, 0.547 grm.

Name of Indicator.	C.c. of Normal Acid consumed.	Grm. of NH ₃ obtained
Litmus	32.4	0.550
Methyl-orange ..	32.4	0.550
Phenacetolin..	32.4	0.500
Phenol-phthalein..	31.5—31.4	0.535—0.533

Before writing the above I had not met with any mention of phenol-phthalein as an indicator for the estimation of ammonia; but quite recently it has been recommended for this purpose by Richter in a paper on a "New Volumetric Determination of Potassium Bichromate, and its Use as a Standard for Caustic Alkalies." (See *CHEMICAL NEWS*, vol. xlvii, p. 19.) The process he has devised may be thus briefly described:—To the caustic soda, potash, or ammonia solution, which has been previously coloured with phenol-phthalein, add standard dichromate of potassium till the reddish yellow colour produced is changed to a full yellow. At this point the alkali is neutralised, a monochromate of the alkali or alkalies is formed, and the reddish tinge due to the presence of the phenol-phthalein in the alkaline solution is discharged when the least excess of acid chromate is consumed. The quantities advised for use are such that the solution in which the titration has been accomplished should measure 150 or 200 c.c., and contain about 1 grm. of the monochromate of potassium. A solution of this salt of the strength mentioned is to be used as a comparison in deciding at what point the end-reaction occurs. Following these instructions as closely as possible, I prepared a decinormal solution of potassium bichromate (14.76 grms. per litre), and also decinormal solutions of caustic soda, potash, and ammonia, the alkali liquors being tested against decinormal sulphuric acid. 50 c.c. of the soda solution was transferred to a beaker, diluted with 50 c.c. of water, coloured with phenol-phthalein, and the decinormal bichromate solution added from a burette. The fine red tint soon changed to reddish yellow, which lost little or none of its intensity till it nearly reached the neutral point. The end-reaction was thus easily observed, especially when compared with the solution of monochromate of potassium of nearly the same strength as that operated upon. It must be carefully noted, however, that the change in colour is not instantaneous, as it is by titration with a mineral acid, so that when the test is nearly finished a minute or two must be allowed to pass after each addition, before coming to any conclusion as to whether the end-reaction has taken place, otherwise a high result will be the consequence. The results of two tests were that 50 and 50.1 c.c. of the decinormal bichromate were consumed, which are as near the truth as possible.

With regard to the determination of the potash, it is sufficient to mention that the results were substantially the same as those obtained with soda.

In estimating the ammonia in 50 c.c. of the decinormal solution of ammonia, the addition of the bichromate produced at first the reddish yellow colour, which slowly disappeared on further addition, and gave place to the full yellow when 45.7 c.c. had been consumed in the one case and 46 c.c. in the other. This gives a result so much below the truth as to be equivalent to 8 per cent of the whole ammonia present. From these results it is quite

plain that Richter had not tested ammonia specially with phenol-phthalein as indicator, but has simply assumed that it would act in precisely the same manner as potash and soda.

TABLE IV.

Comparison of results obtained in the estimation of alkalies by Richter's bichromate and the ordinary acid methods, phenol-phthalein being the indicator.

Amount of soda used for each test			..	0.1550	grm.
„	potash	„ „	..	0.2355	„
„	ammonia	„ „	..	0.0850	„
Name of Alkali determined.	C.c. of $N/10$ $K_2Cr_2O_7$ consumed.	Grm. of Alkali obtained.	C.c. of $N/10$ Acid consumed.	Grm. of Alkali obtained.	
Soda (Na_2O)	.. 50.1	0.1553	50.1	0.1553	
ditto	.. 50.0	0.1550	50.1	0.1553	
Potash (K_2O)	.. 50.1	0.2359	50.1	0.2359	
ditto	.. 50.2	0.2363	50.0	0.2355	
Ammonia (NH_3)	46.0	0.0782	47.1	0.0800	
ditto	.. 45.7	0.0777	46.9	0.0797	

V. Determination of Alkalies Existing as Carbonate and Bicarbonate.

It is not worth while going fully into the results of the tests made on this part of the subject. As almost all the noteworthy points have been already mentioned, I will just note a few necessary precautions. As is well known, litmus can be used in the direct estimation of soda and potash existing as carbonate or bicarbonate by an acid, but can only be applied to the determination of ammonia in that form when excess of acid is added, the solution boiled to expel carbonic acid, and titrated back with an alkali. The same remarks apply to phenacetolin.

Methyl-orange can be employed equally well in the estimation of alkali in any of the alkaline carbonates, but special mention may be made of its application to the determination of ammonia in the commercial carbonate. This substance is a compound of bicarbonate and carbamate of ammonium, and when dissolved in water the latter of these salts takes up the elements of water and produces normal carbonate of ammonium. The sample tested did not contain any impurities except water, and 2.5 grms. converted into chloride and dried at $100^\circ C$. showed 0.725 grm. of ammonia, while two experiments made with 2.5 grms., which consumed 43.1 and 43.05 c.c. of normal sulphuric acid, gave respectively 0.732 and 0.731 grm. of ammonia.

Phenol-phthalein, as stated before, cannot be used for the estimation of ammonia, and in the determination of soda and potash existing as carbonate or bicarbonate (the latter giving no colour with this indicator till decomposed by boiling), a somewhat tedious boiling is required unless excess of acid be added, the solution boiled, and titrated back with caustic soda.

VI. Behaviour of the Indicators with the Sulphates, Nitrates, and Chlorides of the Alkalies.

Having considered the use of the indicators for the estimation of the alkalies when pure compounds are operated upon, we now come to the behaviour of the indicators with the common impurities present in commercial samples. This section, however, is chiefly concerned with the action (if any) of the neutral salts produced during titration. Litmus and phenacetolin are quite as delicate in presence of quantities of the sulphates, nitrates, and chlorides of sodium, potassium, and ammonium, equivalent to 1.55 grms. of soda (Na_2O) per 100 c.c. When these amounts of these salts were tested with the volume of methyl-orange solution used in the foregoing experiments, it was found, as has been already stated, that about 0.2 c.c. of normal acid was required to bring out the full pink colour, as against 0.05 c.c. when distilled water only was employed, although a distinct change was produced with 0.05 c.c. in the former case. On the other hand, the delicacy of phenol-phthalein is not affected by the salts of

sodium and potassium mentioned above, but quantities of sulphate, nitrate, and chloride of ammonium, equivalent to 0.85 grm. of ammonia per 100 c.c., required about 1.5 c.c. of normal caustic soda to produce even the faintest red colour, showing that ammonia and its salts must be carefully excluded when this indicator is made use of.

VII. Effect of the Sulphites of the Alkalies.

A sample of ordinary normal sulphite of sodium was selected, tested for impurities, and the sulphurous acid, sulphuric acid, and soda, determined, to make certain that it was of the proper composition. This was found to be the case, and a solution was prepared, of which 50 c.c. (the amount used for each test) contained 3.15 grms. of sulphite of sodium. This is equal to 1.55 grms. of soda (Na_2O).

Litmus.—On adding the normal acid to the portion tested with this indicator, the solution remained quite blue till about 12 c.c. had been added, but after that it became purple, and slowly passed into the red. The end-reaction was observed by comparing with a solution containing the same quantity of litmus reddened. 24.9 c.c. were consumed, which is equal to 0.772 grm. of soda, or very nearly half that contained in the sulphite of sodium. When boiled the colouring matter is destroyed.

Methyl-orange.—In this case 25.1 c.c. of the normal acid were consumed, which is equal to 0.778 grm. of soda, a result slightly higher than that obtained by litmus, but still practically the same. The end-reaction was unlike that of litmus—very sharp and decided.

Phenacetolin.—With phenacetolin the result was exactly the same as that procured with methyl-orange, but, as in the case of litmus, the colour changed so gradually that the end-reaction was not very sharply defined.

Phenol-phthalein.—Sulphite of sodium is practically neutral to phenol-phthalein, but, as has been shown, it is strongly alkaline to the other three indicators. Only 0.2 c.c. of normal acid was necessary to discharge the red colour in the cold, but when boiled 4 c.c. were required. On cooling and titrating back, 3.8 c.c. of normal alkali were consumed, so that when this method is employed the practical neutrality of sulphite of sodium may be depended upon, provided too much acid is not added before boiling. If a large excess of acid were used the boiling would expel sulphurous acid, and a high result would be the consequence. It need only be added that potassium and ammonium sulphite act towards these indicators in the same way as the sodium compound, except in the case of the ammonium salt with phenol-phthalein, which cannot be used in presence of ammonium compounds.

TABLE V.

Results obtained in the titration of sodium sulphite with normal acid.

Amount of Na_2SO_3 used for each test .. 3.15 grms.
Equal to Na_2O „ „ „ .. 1.55 „

Name of Indicator.	C.c. of Normal Acid consumed.	Grms. of Na_2O obtained.
Litmus	24.9	0.772
Methyl-orange	25.1	0.778
Phenacetolin	25.1	0.778
Phenol phthalein (cold).	0.2	0.006
„ (boiled)	4.0	0.124

VIII. Effect of Thiosulphate of Sodium.

This salt, which is known better as hyposulphite of soda, is perfectly neutral to litmus, methyl-orange, phenacetolin, and phenol-phthalein.

IX. Effect of Sulphide of Sodium.

To obtain pure normal sulphide of sodium, a solution of sulphuretted hydrogen was prepared, the strength of which was determined by oxidation in an alkaline solution with peroxide of hydrogen and precipitation with chloride of

barium. Exactly enough hydrate of sodium was now added to form Na_2S , and the solution made up to such a volume that 50 c.c. (the quantity operated upon) contained 0.284 grm. of the sulphide.

Litmus.—When thoroughly boiled after each addition of acid to expel the sulphuretted hydrogen an excellent result was obtained, 7.2 c.c. of normal acid being consumed. This is equal to 0.290 grm. of sulphide of sodium.

Methyl-orange.—With this indicator the same number of c.c. of acid was consumed as with litmus. The liberated sulphuretted hydrogen had evidently no effect on the colour, as the end-reaction was quite sharp. This has been pointed out by Lunge. Phenacetolin behaves in much the same way as litmus, the boiling off of the sulphuretted hydrogen being necessary to the obtaining of a decided change in colour when the end of the experiment is reached. The result was the same as that obtained with litmus.

Phenol-phthalein gave rise to the characteristic red colour with the sulphide of sodium, but the colour was discharged after the addition of 3.55 c.c. of normal sulphuric acid. This is practically equal to half of the sodium sulphide, and shows that the sodium hydrogen sulphide, which is formed by the combination of the normal sulphide with the liberated sulphuretted hydrogen, is neutral to phenol-phthalein. On boiling the solution the red colour returned, and altogether 7.15 c.c. of the acid were consumed, the whole of the sodium sulphide being thus estimated.

Potassium and ammonium sulphides have exactly the same effect as the sodium compound, always excluding phenol-phthalein with regard to the ammonium salt.

TABLE VI.

Results obtained in the titration of sodium sulphide by normal acid.

Amount of Na_2S employed for each test.. 0.284 grm.

Name of Indicator.	C.c. of Normal Acid consumed.	Grm. of Na_2S found.
Litmus.. .. .	7.2	0.280
Methyl-orange	7.2	0.280
Phenacetolin	7.2	0.280
Phenol-phthalein (cold)	3.55	0.138
„ (boiled)	7.15	0.278

X. Effect of the Phosphates of the Alkalies.

As the normal phosphate of potassium is generally found to the extent of 1 or 2 per cent (it has even been found as high as 7 per cent) in commercial carbonate of potash, it is a matter of great importance to know what proportion of the potash existing as phosphate is determined by standard acid. I found that the phosphates of potassium, sodium, and ammonium acted in the same manner towards the indicators when titrated with standard acid, and will therefore only quote the double series of experiments made, the one with normal sodium orthophosphate (Na_3PO_4), and the other with the ordinary disodium hydrogen orthophosphate (Na_2HPO_4). The crystallised form of the former of these salts was prepared by dissolving a weighed quantity of the latter in boiling water, adding the proper proportion of hydrate of sodium, and allowing to crystallise out. After re-crystallising both of these phosphates, a portion of each was ignited to obtain the real amount of dry salt in each, and solutions made of such a strength that 50 c.c. contained, in the one case, 2.05 grms. Na_3PO_4 (equal to 1.162 grms. Na_2O), and in the other 1.775 grms. Na_2HPO_4 (equal to 0.775 grm. of Na_2O).

When *Litmus* was used in the titration of the normal phosphate, the blue colour remained intact until about 16 c.c. of the normal sulphuric acid were added, when it became purple, and on further addition slowly passed into red, the change being complete at about 24.9 c.c. This is equal to 0.772 grm. of soda, which is practically two-thirds of the total soda. The point at which the red

colour was fully developed could not be ascertained with any degree of accuracy, even when a solution of reddened litmus was used for comparison, as the change was so very gradual. The mono-acid phosphate consumed 12.4 c.c. of the standard acid, thus agreeing with the result of the normal phosphate.

Methyl-orange gives as delicate an end-reaction as with hydrate of sodium. The results were slightly higher, and nearer the truth than those obtained with litmus, 25.05 c.c. being required in the one case, and 12.6 in the other.

Phenacetolin.—With this indicator the same number of c.c. were necessary as with litmus, and, like the latter, it changes gradually in colour, so that the point at which excess of acid is added is somewhat difficult to catch. There is, however, a peculiar phenomenon to be noticed with regard to this indicator. The normal phosphate, like hydrate of sodium, only brings out the scarcely perceptible yellow colour, but after the addition of about 11 c.c. of the normal acid, the permanent pink colour is formed. In fact, the first-named salt acts towards phenacetolin as if it were a mixture of hydrate and the mono-acid phosphate of sodium. The latter salt produces the pink colour at once.

Phenol-phthalein, again, acts in an entirely different way to the other indicators. We have seen before that NaHCO_3 , NaHS , and Na_2SO_3 are neutral to this indicator, and to these must now be added Na_2HPO_4 , while NaHSO_3 and NaH_2PO_4 are neutral to litmus, methyl-orange, and phenacetolin, NaHCO_3 and NaHS being alkaline, and not requiring to be decomposed by boiling before determining the alkali in them by test acid. It will be observed that in each case there is exactly an atom of sodium of difference, the phenol-phthalein being invariably the weaker indicator.

In titrating the normal phosphate 12.65 c.c. of the test acid were required to discharge the red colour in the cold, and 13.7 c.c. in the boiling solution, the mono-acid phosphate requiring only 0.25 in the cold, and 1.4 in the hot. In each case, on cooling and titrating back with caustic soda, the same result as was obtained at first in the cold solution was brought out. These results show that when phenol-phthalein is employed, one-third of the soda in normal phosphate of sodium is estimated by standard sulphuric acid, and only a trifling portion of that existing as the mono-acid phosphate.

TABLE VII.

Results obtained in the titration of normal sodium phosphate and disodium hydrogen phosphate by normal acid.

Na_3PO_4 used for each test 2.050 $=\text{Na}_2\text{O}$ 1.162 Na_2HPO_4 1.775 $=\text{Na}_2\text{O}$ 0.775					
Name of Indicator.	Na_3PO_4 .		Na_2HPO_4 .		
	C.c. Normal Acid consumed.	Grm. of Na_2O found.	C.c. Normal Acid consumed.	Grm. of Na_2O found.	
Litmus	24.9	0.772	12.4	0.384	
Methyl-orange	25.05	0.776	12.6	0.390	
Phenacetolin (1st change)—	11.0	0.341	—	—	
„ (2nd change)—	24.9	0.772	12.4	0.384	
Phenol-phthalein (cold)—	12.65	0.392	0.25	0.008	
„ (boiled)—	13.7	0.425	1.4	0.043	

(To be continued.)

Researches on Mesitylene.—G. Robinet.—The author has obtained mono- and di-chloride, di-bromide mesitylenic acid, dimethyl-phenylacetic acid, and mesitylene picrate.—*Comptes Rendus*.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, March 10th, 1883.

Professor G. C. FOSTER in the Chair.

New Member:—Major W. S. Boileau.

Mr. SHELFORD BIDWELL read a paper "*On a New Method of Measuring Resistances with Constant Currents.*" It consists in placing a resistance box in the arm of the bridge, which afterwards has to contain the unknown resistance. A balance is effected by unplugging resistance in this box. The unknown resistance is then inserted in the same arm, and the balance restored by plugging resistance out of the box. The amount plugged out equals the unknown resistance.

Prof. F. GUTHRIE made a communication on "*Liquid Slabs.*" Films of liquid spread out like a flattened drop on a solid surface are found by the author to have a thickness which is a physical constant for the same liquid, provided the area is very great in proportion to the thickness. Sodium amalgam inserted in a mercury slab causes it to spread out further. Prof. Guthrie also finds that an electric current increases the diffusion of sodium amalgam through mercury in the direction of the current.

Mr. BAILY suggested that as the diffusion produces a current an opposing current might be found to stop the diffusion.

Mr. STANLEY said the largest water drop he had measured was one-fifth of an inch.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

January 22, 1883.

Mr. ROBERT R. TATLOCK, F.C.S., President, in the Chair.

A MEETING of this Section was held within the Society's Rooms, 207, Bath Street, on the above evening.

After the usual preliminary business had been transacted Mr. ROBERT T. THOMSON read a paper "*On the Use of Litmus, Methyl-orange, Phenacetolin, and Phenol-phthalin as Indicators*" (see p. 123).

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 7, February 12, 1883.

Researches on the Chromates.—M. Berthelot.—A thermo-chemical paper treating of the solution heat of potassium and ammonium bichromates and of chloro-chromic acid, the heat of the neutralisation of chromic acid by potassa and ammonia, and the reaction of acids with the chromates.

The Theory and the Experiments of Mercadier and Waschy tending to Establish the Non-Influence of the Di-electric upon Electro-dynamic Actions.—Maurice Lévy.—A mathematical paper, not adapted for abstraction.

General Method for Reinforcing Telephonic Currents.—James Moser.—The author constructs a battery of telephones by which he can give to the current any desired strength.

Lead and Ammonium Chlorides and Lead Oxy-Chlorides.—G. André.—The author has obtained a certain number of double chlorides of lead and ammonium by dissolving in heat pulverised lead chloride in solutions of ammonium chloride, saturated first in cold, and then in heat.

Preparation of Ethers of Trichloroacetic Acid.—A. Clermont.—The author mixes equivalent proportions of alcohol and of crystalline trichloroacetic acid, adds the quantity of monohydrated sulphuric acid indicated by theory for the formation of its bihydrate. The mixture becomes turbid, and on adding a suitable quantity of water, trichloroacetic acid settles to the bottom of the vessel.

Contribution to the Study of Isomerism in the Pyridic Series.—Æchsner de Coninck.—The author has succeeded in demonstrating the existence of two isomeric lutidines in the crude quinoline derived from brucine.

Relative Toxic Power of Metallic Salts.—Dr. J. Blake.—The author shows that the toxic power of the metals does not, as is maintained by M. Rabuteau, follow in the regular series of their atomic weights, but that this order can only be traced in the isomorphous groups.

No. 8, February 19, 1883.

Results of the Experiments made by M. Deprez in the Laboratory of the Northern Railway of France on the Electric Transportation of Work to Great Distances.—M. Tresca.—The work really transmitted to the distance of $8\frac{1}{2}$ kilometres by an ordinary telegraphic wire of 4 m.m. in diameter, arranged on the method of M. Deprez, represents one-third of the moving work. If, whilst the currents remain the same, we leave out of view the resistance of the intermediate circuit, the corresponding useful effect may rise to nearly the half of the motor work.

Report on a Memoir by M. Rosenstiehl, entitled "Researches on the Colouring-Matters of Madder."—A. Wurtz.—The author, after giving a very full account of successive discoveries concerning the colouring principles of madder, summarises M. Rosenstiehl's results. The latter shows that madder, apparently so complicated, contains in reality only three glucosides: that which yields pseudo-purpurine or carboxyl-purpuric acid, that which yields carboxyl-alizaric acid, and that which yields munjistine, or carboxyl-xantho-purpuric acid.

Crystals observed in the Interior of a Bar of Swedish Iron after Cementation.—L. Stoltzer.—In a bar, which had been placed in the hottest part of the furnace, there were remarked blisters occupied by regular octahedral crystals.

Proximate Analysis of Pozzolanas, and a Rapid Method of Testing their Hydraulic Value.—E. Landrin.—The author shows that the silica liberated from these bodies is a hydraulic silica in its most efficient state. The method proposed for the test is treatment with hydrochloric acid, removal of the soluble portion by filtration, and washing, and treatment of the insoluble portion with lime water. The more lime it withdraws from solution, the better is the quality of the cement.

Sulpho-cyano-propimine.—J. Tcherniac and T. H. Norton.—The authors have obtained and examined the sulpho-cyanate, nitrate, and chloro platinate of sulpho-cyano-propimine, its acetyl compound, and its hydriodate.

Allotropic Arsenic.—R. Engel.—The author concludes that arsenic exists in two distinct states. Whenever it is isolated, either by the moist or the dry way, below 360° , it is amorphous, dark grey, brown or black, and not affected by moist air. Its specific gravity is from 4.6 to 4.7. If heated to 360° it is converted into the other modification, of sp. gr. 5.7. Nitric acid attacks it more or less readily according to its state of division. This variety, commonly met with in laboratories, crystallises when it is formed by the condensation of its vapour about or above 360° .

The Vision of the Ultra-Violet Radiations.—M. de Chardonnet.—The author asks what becomes of the ultra-violet rays absorbed by the media of the human eye, and what form is taken by the energy thus transformed? It is probable that this transformation does not take place without fatigue to the organ, especially in case of the long and brilliant ultra-solar spectrum of the electric arc. On the other hand the spectrum of the incandescence-light does not go far beyond the visible spectrum. Hence this light saves the eye from the labour of absorbing and transforming the ultra-violet rays.

Journal für Praktische Chemie.

New Series, Vol. xxvi, Part 9, No. 20, 1882.

Researches on the Aluminates and the Basic Haloid Salts of Barium, and Notes on Barium Hydrate and the Haloid Salts of Barium.—Dr. Ernst Beckmann.—The author remarks that not merely sodium aluminate but barium aluminate is finding extensive application in dyeing, printing, and sugar making. He first examines the behaviour of aluminium hydroxide, aluminium chloride, and aluminium with solution of baryta, and of aluminium barium with water. With the hydrate baryta water forms at first a soluble compound of the composition $\text{Al}_2\text{O}_3\text{BaO} \cdot \text{aq}$. If this solution is heated for a length of time with an excess of aluminium hydroxide, there is formed some insoluble aluminate. The hydrate is rendered less soluble by prolonged contact with water at common temperatures. If baryta water is added to solution of aluminium chloride, there is formed a precipitate of alumina, containing mere traces of baryta, whilst barium chloride remains in solution. Metallic aluminium is briskly attacked by baryta water, whilst aluminium hydroxide is deposited as a powder. The author then describes the compounds of aluminium and barium at some length.

Behaviour of the Conglutine from Lupin Seeds with Saline Solutions.—H. Ritthausen.—Lupins contain two proteines, conglutine and legumine, the former in much larger proportion than the latter. They are best separated by dissolving both together in water containing potassa, allowing the solution to stand for some time in the cold, precipitating with hydrochloric or acetic acid, drying the precipitate over sulphuric acid, and treating it with a 5 per cent solution of common salt. Conglutine dissolves and legumine remains insoluble.

Albumenoids of Peach-Kernels and the Press-cake of Sesame Seeds.—H. Ritthausen.—The body obtained from peach-kernels closely agrees with the conglutine of lupins. The albumenoid of sesame cake contains less sulphur than the author obtained in some former experiments.

Nitrophenyl-Ethers of Tribasic Formic Acid.—A. Weddige.—An account of the ortho- and para-compounds.

Preparation of Chloro-carbonic Methyl-ether.—A. Klepl.—The author passes purified chloro-carbonic oxide into diluted methylic alcohol.

Parts 10 and 11.

Meconic Acid and certain of its Derivatives.—Ernst Memel.—The author describes the mono-, di-, and tri-ethyl-ethers of meconic acid, ethyl-meconic acid with its lead salt, ethyl-comenic acid and its silver salt; the action of ammonia upon mono-ether-meconic acid, mono-meconaminic acid; the action of bromine upon meconic acid and its ethers, brom-oxyl-brom-komenic acid, and brom-oxyl-brom-komenic ether. He concludes from his experiments that meconic acid is a dibasic oxy-acid, for which view the tri-ethyl-ether and its derivatives, ethyl-meconic and ethyl-comenic acids, supply a proof. The hydroxyl of meconic acid is comparable to phenol-hydroxyl. Consequently the silver salt regarded by Liebig as neutral is in its composition analogous to the so-called basic

sodium salicylate. The compounds which in watery solution have a neutral reaction and have hitherto been termed mono-acid, are true neutral salts of meconic acid.

Researches on the Aluminates and the Basic Haloid Salts of Barium, with Notes on Barium Hydroxide and the Haloid Salts of Barium.—Dr. Ernst Beckmann.—The author here studies the compounds of alumina with barium chloride; those with barium bromide; with the corresponding iodide; the compounds with barium nitrate, and acetate.

Communications from the Chemico-Agricultural Laboratory of the University of Königsberg.—H. Ritthausen.—These consist of an account of the behaviour of legumine with saline solutions. The seeds in which legumine is present contain it as a substance soluble in saline liquids, but capable of being converted by alkaline liquids containing free alkaline hydrate into the insoluble modification, without decomposition.

Bulletin de la Société Chimique de Paris.

No. 1, January 5, 1883.

Studies on the Combustion of Explosive Gaseous Mixtures.—MM. Mallard and Le Chatelier.—This paper has been already noticed under the *Comptes Rendus*.

Researches on the Passage of Alcoholic Liquids through Membranes.—H. Gal.—Already noticed.

Isomorphism of Mass.—D. Klein.—Already noticed.

Method of Converting Tricalcic Phosphate into the Phosphorus Chlorides.—J. Riban.—The author passes chlorine and carbon monoxide over a mixture of charcoal and tricalcic phosphate at a temperature of 180° . The products are phosphorus oxy-chloride, calcium chloride, and carbonic acid.

Isomeric States of the Haloid Salts.—M. Berthelot.

Double Decompositions of the Haloid Salts of Silver.—M. Berthelot.

Researches on Lead Iodide.—M. Berthelot.—These three thermo-chemical papers have been already noticed.

No. 2, January 20, 1883.

Butyric Ferment of Arable Soil.—P. Dehérain and L. Maquenne.

Double Salts prepared by Fusion.—MM. Berthelot and Illosvay.

Reciprocal Displacements of Halogenous Bodies and the Secondary Compounds which Preside in it.—M. Berthelot.—These three papers have been already noticed.

Swedish Correspondence.—P. T. Clève.—Including:—

α -Chlorated Naphthyl Sulphurous Acid.—K. E. Arnell.—The author determines the constitution of α -chlorated naphthyl sulphurous acid, and of the corresponding bromine compound.

Nitro-Derivatives of the Naphthyl Disulphurous Acids.—I. E. Alen.—An account of the mono-nitro- and dinitro-compounds.

Journal de Pharmacie et de Chimie.

Tome vii., February, 1883.

Pneumo-enteritis of Swine.—M. Pasteur.—This paper has no chemical interest.

Extraction of the Colouring-Matters of Blue Urine, Indigotine, and Indirubine.—C. Méhu.—The author renders the urine in question distinctly acid by the addition of a few drops of sulphuric acid, and then saturates it with ammonium sulphate as a dry powder. The pigments urobiline, bilirubine, biliverdine, &c., are immediately separated. The liquid is filtered, the precipitate washed with a small quantity of a saturated solution of

ammonium sulphate. To obtain the whole of the blue (indigotine) and red (indirubine) of violet or blue urine it is sufficient to proceed as already indicated, adding the sulphuric acid drop by drop, so as to leave about 1 grm. of free sulphuric acid per kilo. of liquid. Ammonium sulphate is then added in large excess. The precipitate and filter are washed as before with a saturated solution of ammonium sulphate slightly acidified with sulphuric acid. The dry filtrate is of a violet colour, and retains ammonium sulphate, sometimes albumen, urates, various histological elements, and lastly the small trace of the blue and red colouring-matters. The indirubine is dissolved out by treating the dry filter with alcohol at 50 per cent. Solvents appear to act differently upon the indigotine from indigo and the indigo from urine.

Possible Purification of Denaturised Alcohol.—MM. P. Cazeneuve and Chapuis.—By means of hydrogenisation the acetone present in methylated spirit can be almost entirely destroyed in about twenty days.

A Case of Physical Isomerism of Camphor Monochloride.—P. Cazeneuve.—Already noticed.

Properties of Invertine.—E. Bourquelot.—Invertine has not a saccharifying action upon starch-paste.

Experimental Researches upon the Appearance of Phosphoric Acid in Urine.—Léon Eymonnet.

Researches on the Elimination of the Hypophosphites by the Urine.—L. Eymonnet.—These two papers are more of a medical than a chemical character.

Organisms Developed in Phenic Solutions.—Dr. Fessinger.—Aërobic vibrios are able to vegetate in phenic solutions, whilst the anaërobic forms are excluded.

Justus Liebig's Annalen der Chemie,
Band 216, Hefts 1 and 2.

Researches on Uranium (Second Memoir).—Clemens Zimmermann.—The author determines the vapour-density of uranium bromide and chloride, for the former of which he finds the mean value 19.46, and for the latter 13.21; these figures approximate closely to those found by calculation on the assumption that $U=240$. The specific gravity of metallic uranium in the fused state, referred to water at 4° and to a vacuum, is 18.685. The atomic volume of uranium is 12.84, and its specific heat 0.02765. The author's results fully confirm the conclusions of Mendelejeff that the atomic weight of uranium = 240, and that it must rank with chromium, molybdenum, and tungsten in the sixth group of the periodic system. The memoir includes an account of the chief reactions of the uranous salts, and of the properties of metallic molybdenum.

Communications from the Chemical Institute of the University of Strassburg.—These consist of researches on the non-saturated acids, conducted under the superintendence of Professor Rudolph Fittig, and including papers: on two new Caprolactones, by Leo Gottstein; on a new hepto- and octo-lactone, by Sidney Young; on a peculiar decomposition of the substituted acetyl-acetic ethers, by the same chemist; on the lactones from allyl-malonic acid, diallyl-malonic acid, and diallyl-acetic acid, by Ed. v. Hjelt; on itamalic acid, para-conic acid, and aconic acid, by Alexander Beer; on phenyl-butyro-lactone and phenyl-paraconic acid, by H. W. Jayne; on phenyl-oxy-pivalic acid, by Rud. Fittig and H. W. Jayne; on phenyl-homo-paraconic acid, by S. L. Penfield; on the delta-lactone of the normal capronic acid, by L. Wolff; on cumarine, by G. Ebert; on cumarilic acid, by R. Fittig and G. Ebert; on hydropiperic acid and piperhydnric acid, by Eugen Buri; and on the action of sulphuric acid upon cinnamic acid with the aid of heat, by Ernst Erdmann.

Communications from the Laboratory of the University of Göttingen.—These comprise memoirs by Rud.

Gissmann on the behaviour of durol with chromic acid, and on dinitro-durylic acid; by H. Aschenbrandt on para-diethyl-benzol, and by H. Körner on para-dinormal-propyl-benzol.

On Hæmatoxyline and Hæmateine.—E. Erdmann and G. Shultz.—The hard crystalline deposit adhering to vats in which extract of logwood had been kept was ground up with water to a paste and extracted in large bottles with much ether. The ethereal extract was drawn off when clear; the ether distilled off, and the syrupy extract mixed with hot water. The hæmatoxyline crystallises out and may be purified by re-crystallisation. From dilute solutions are obtained columnar, often hollow needles containing 3 aq; but from more concentrated solutions rhombic tables with 1 aq. From the mother-liquors, on concentration, there are sometimes deposited shining leaflets of hæmateine—a proof that this product exists pre-formed in the raw material. The authors saw no reason to question Gerhardt's formula $C_{16}H_{14}O_6$. They consider that it contains only five hydroxyl-groups. The authors find that the yield and purity of hæmateine are greatly influenced by the duration of the process. It is best to pour the ammoniacal solution of hæmatoxyline into roomy, shallow glass capsules, so as to afford the largest possible surface; to keep up a constant small excess of ammonia by the occasional addition of a few drops, and to take from time to time small samples and mix them with acetic acid in a test-tube. As soon as a precipitate appears immediately, or after a short time, and on boiling is converted into crystalline scales, the experiment is stopped, the whole product is heated to boiling in a flask and neutralised with acetic acid. The composition of hæmateine is expressed by $C_{16}H_{12}O_6$. The authors, in opposition to Benedict, find no trace of nitrogen in hæmateine. Hæmateine is scarcely soluble in boiling water. It dissolves freely in hydrochloric acid, and crystallises out in small, dark-red needles. In sulphuric acid it dissolves also to a red liquid, which, on mixture with water, deposits a red powder, not stable if filtered off. It redissolves on the application of heat, unless an excess of water is present, and on cooling crystallises in needles. Sulphurous acid, and especially alkaline bisulphites, quickly dissolve hæmateine in great quantity, forming an almost colourless solution. There is, however, here, no reduction to hæmatoxyline. There are formed very soluble addition products; that with sulphurous acid is partially decomposed by boiling, whilst that with sodium bisulphite is decomposed on heating with an acid, and deposits hæmateine. The authors could not by any method succeed in re-producing hæmatoxyline from *this* hæmateine. Reim, however, obtained from hæmatoxyline another oxidation-product which he, indeed, considers identical with Erdmann's hæmateine, but which, though possessing the same percentage composition, are totally different in their behaviour. Reim's derivative appears in the form of brownish-red needles, which dissolve in boiling water much more freely than Erdmann's hæmateine. The solution in sulphuric acid does not give a red precipitate when mixed with water. Above all, Reim's product is at once reduced to hæmatoxyline on boiling with sulphurous acid. Meyer's observation that hæmatoxyline, when submitted to dry distillation, yields a mixture of resorcine and pyrogallallic acid, was decidedly confirmed. The two compounds may be approximately separated by extraction with boiling benzol, in which pyrogallallic acid is more readily soluble.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xii., Part 1.

Experimental Researches on the Particular Influences of the Elements of Arable Soil upon the Evaporation of Water.—F. Masure.—The author views soils as essentially composed of four materials, sand, whether siliceous, calcareous, or felspathic, pulverulent

limestone, clay, and humoid matter formed from the decomposition of dung and organic matter in general. He examines the capacity of saturation of these ingredients, the rate at which they dry, their permeability, density, hygroscopic power, condensing power, power of becoming heated by the sun's rays, of becoming aerated, and nightly cooling. From these results he draws conclusions as to the cultivation of sandy, calcareous, and clayey soils. He calls attention to certain physical properties of farm-yard manure which he pronounces "the most valuable agent for the improvement of soils." He considers that artificial manures will always be useful auxiliaries, though farm-yard manure must remain the foundation of agriculture.

Comparative Sylvan-Meteorological Observations.—Herr Fankhäuser, Cantonal Forester of Berne.—The observations of the author go to show that the mean temperature of the soil is somewhat lower in a wood than in the open fields. The mean yearly temperature of the air is also higher in the fields than in the woods, the difference being greater in spring and summer than in autumn and winter. In spring and summer the soil is colder than the trees, but warmer in autumn and winter. The air of a forest is more moist than that of the fields, the difference being greatest in summer. Evergreen trees have more action in this respect than such as are deciduous. The mean rain-fall in woods was found greater than in the neighbouring fields, but little value can be attached to this result since it is impossible to estimate the quantity of moisture which runs down the trunks and branches of trees.

Influence of Climate and Weather on the Carbonic Acid of the Ground Air.—Dr. E. Wollny.—The fluctuations of carbonic acid in the ground-air depend on a complication of factors which act sometimes in concert and sometimes in opposition.

Rise of Temperature of Different Constituents of the Soil and Kinds of Soil on the Condensation of Liquid and Aëriform Water and of Gases.—Aug. Stellwagg.—The rise of temperature thus effected deserves consideration only in case of soils rich in humus or in iron, and in a dry condition.

Decomposability of Nitrogenous Animal Matters.—Dr. A. Stutzer and W. Klingenberg.—The authors determined the solubility of dried blood, ground leather, horn-dust, wool waste, &c., by treatment with a solution of pepsine. The results obtained agree substantially with practical conclusions as to the value of the various manurial matters.

Manurial Experiments of the Noorder Afdeeling.—G. Reinders.—A series of experiments have been carried on in Holland since 1870, mainly, it would seem, to test the published views of Prof. G. Ville, and according to the plan proposed in his work. In the first mentioned experiment with oats, Ville's complete manure gave the best results in grain; next came farm-yard manure, chemical manure without nitrogen, ditto without phosphoric acid, (which, however, yielded the heaviest crop of straw). With wheat the following year the results were very different: farm-yard manure took the lead, followed by manure without nitrogen. Then came complete manure, very little better than the unmanured check-plot, and lastly manure without phosphoric acid. For barley, the order obtained was: manure without nitrogen, complete manure, farm-yard manure (very little inferior), the unmanured plot, and manure without phosphoric acid. In straw the complete manure had a distinct advantage. In a more extended set of experiments upon rape-seed, barley, rye, oats, red clover, wheat, and tares, the complete manure proved distinctly superior to farm-yard manure in every case. A manure wanting only in gypsum gave better results for tares and gypsum than the complete manure itself. The absence of phosphoric acid causes the greatest deficiency, then in succession that of nitrogen and of potassa.

Manurial Experiments on Forest Trees.—M. E. Muel.—A complete manuring was not found remunerative, and the addition of nitrogen was prejudicial. Mineral manures assisted the growth of the trees.

Poisoning of Plants.—Dr. C. Krauch.—The author has examined the action of ammonium sulpho-cyanide, of salts of zinc, and of common salt. The first mentioned salt is a violent poison to plants; the second has an injurious action, though it is even necessary for *Thlaspi calaminare* and *Vida multicaulis*. Common salt is not injurious in the proportions in which it is likely to occur in ordinary soils.

Cosmos Les Mondes.

No. 5, February 3, 1883.

Mining by Fermentation.—The yeast of beer has been proposed as a means of breaking up rocks, ores, &c. Experiments are to be performed in the Comstock mines.

MEETINGS FOR THE WEEK.

MONDAY, March 19.—London Institution, 5.

Medical, 8.30.

TUESDAY, 20th.—Society of Arts, 8. "Social and Commercial Aspects of New Zealand," by William DeLisle Hay.

Institution of Civil Engineers, 8.

Pathological, 8.30.

WEDNESDAY, 21st.—Meteorological, 7.

Geological, 8.

THURSDAY, 22nd.—Society of Arts, 8. "Self-Purification of River Waters," by W. N. Hartley, F.R.S.E.

London Institution, 7.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Linseed Oil.—Can any of your readers inform me where I can obtain a good process for the refining of raw linseed oil, *i.e.*, deodorising and decolourising?—SAPO.

Blowpipe Analysis.—Benzoline.—Is there any recent work (in English) on the blowpipe which gives a general scheme for the analysis of minerals without the use of liquid tests, something after the style of Dana's tables for identification, only carried out further? Plattner gives a number of reactions, &c., but chiefly with regard to salts and oxides more or less pure. He does not give a method for analysing a mineral by blowpipe only without solution and precipitation. What is the best method for purifying commercial benzoline so as to remove the nauseous odour? I suppose that "petroleum ether" is the same thing as benzoline?—SM.

TO CORRESPONDENTS.

T.R.H.—If the gold is pure it will dissolve in aqua regia without leaving a residue. The deposit you speak of is most probably chloride of silver.

ST. PAUL'S SCHOOL.—An Examination for filling up about Six Vacancies on the Foundation will be held on the 10th April, 1883.—For information apply to the Clerk to the Governors, Mercers' Hall, E.C., or to the School Secretary St. Paul's Churchyard, E.C.

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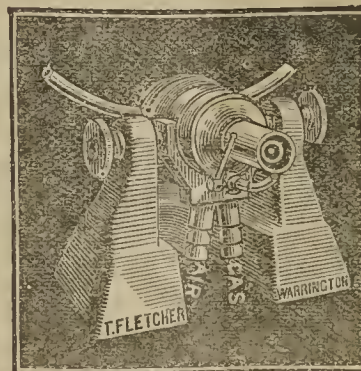
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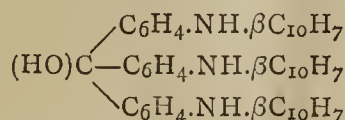
By GEORGE D. LIVEING, F.R.S., Professor of Chemistry, and J. DEWAR, M.A., F.R.S., Jacksonian Professor, University of Cambridge.

IN our communications on the reversal of the lines of metallic vapours, we have several times noticed (*Proc. Roy. Soc.*, vol. xxviii., pp. 357, 369, 473), the reversal of the lithium lines, and concluded that the blue line is more easily reversed than the orange line. This, however, does not appear to be really the case. When much lithium is introduced into the arc, a second blue line is developed close to, but slightly more refrangible, than the well-known blue line. This second blue line produces with the other the appearance of a reversal, which deceived us until we became aware of the existence of the second line. The blue line (wave-length 4604) is really reversed without difficulty when sufficient lithium is present, but under these circumstances the orange line is also reversed. The latter line is also the one which first (of the two) shows reversal, and also the one which is more persistently reversed. Hence we place the lines in order of reversibility as follows: red, orange, blue, green, violet.

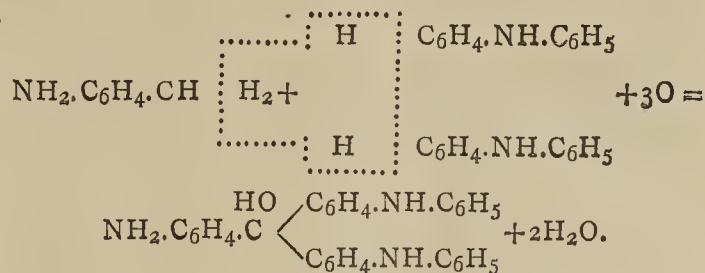
ON SOME COLOURING MATTERS BELONGING TO THE ROSANILINE SERIES.

By RAPHAEL MELDOLA.

NAPHTHYLATED derivatives of rosaniline analogous to the phenylated blues are at present imperfectly known owing to the difficulty of substituting the radicle $C_{10}H_7$ for the amido-hydrogen of rosaniline by the ordinary method. I found some time ago, however, that this substitution could be readily effected by employing β -naphthylamine. It is only necessary to heat the rosaniline base with an excess of the β -naphthylamine to a temperature a few degrees above the melting-point of the latter for a short time (about 15 to 20 minutes), in the presence of a small quantity of benzoic or acetic acid, when ammonia is freely evolved, and a rich blue melt is produced. The product, after purification by the usual methods, can be converted into sulphonic acids, which dye silk or wool of a deep blue, having a more reddish tint than the corresponding sulpho-acids of triphenylrosaniline. Pararosaniline was employed in this experiment so that the constitution of the tri- β -naphthyl-pararosaniline base might be thus represented:—



An experiment was also made, having for its object the production of a phenylated derivative of pararosaniline by direct oxidation. Thus, when a mixture of one molecule of paratoluidine and two molecules of diphenylamine is heated in the presence of an oxidising agent, the following reaction might be expected to take place†:—



The experiment was found to be successful when the mixed ingredients were dissolved in glacial acetic acid and heated for some time (two to three hours) with the theoretical quantity of As_2O_5 necessary to furnish the requisite amount of oxygen. The product, when purified, was a purple dye-stuff, which could be converted into a sulphonic acid by the ordinary methods, and possessing all the properties of a diphenyl-rosaniline.

Atlas Works, London, E.

ANALYSIS OF ASH OF *PISTIA STRATIOTES*, "PÁNÁ SALT."

By C. J. H. WARDEN, Bengal Medical Staff, Chemical Examiner to Government.

THE *Pistia stratiotes* plant is described by Roxburgh as found swimming on pools of stagnant water in most parts of India, and having much the appearance of half-grown lettuce plants. In Bengalee and Hindoostanee it is known as "taka páná," and the saline matter obtained by lixiviation of its ash as "páná salt."

In the Dinagepur district this salt is prepared as follows: A large quantity of the plant is collected in the cold season, when it becomes matured, and dried and incinerated. The ash is then put into a piece of cloth, tied between pegs, and percolated with water, and the saline solution evaporated to dryness in a pot over a fire. According to the Collector of Dinagepur, páná salt is not largely manufactured in that district; the little that is made is almost entirely used for medicinal purposes by Kubirajis and as a domestic remedy. It is very rarely employed as a substitute for common salt.

Specimens of the plant, and salt, were received from the Kinagepur district, and yielded on analysis the following results. The weed, dried at 130°C ., was carbonised at a temperature below redness and exhausted with boiling distilled water: the insoluble residue being subsequently incinerated until free from carbon.

Total ash..	..	..	..	..	31.4583	per cent.
Soluble ash ..	..	..	..	..	6.1426	"
Insoluble ash ..	..	..	..	..	25.3463	"

The sample of páná salt weighed about 2 lbs., it was slightly deliquescent, alkaline in reaction, and had the appearance of dirty common salt. Dried at 130°C . it had the following percentage composition:—

Potassic chloride, KCl}..	..	73.0916	per cent.
Potassic sulphate, K_2SO_4 ..	..	22.6130	"
Potassic carbonate, K_2CO_3..	..	traces	"
Sodic chloride, NaCl} ..	..	0.4727	"
Calcic sulphate, CaSO_4 ..	..	0.5874	"
Magnesian sulphate, MgSO_4..	..	0.2574	"
Ferric and aluminic oxides, $\text{Fe}_2\text{O}_3, \text{Al}_2\text{O}_3$ ..	..	0.0982	"
Sand and silicic oxide, SiO_2	..	0.3673	"
Organic matter ..	..	0.3575	"
Water ..	..	1.8674	"

99.7125 "

Nitrates, nitrites, and phosphates were absent. Not

* A Paper read before the Royal Society, March 8, 1883.
† The free base of the substituted rosaniline is assumed to be produced for the sake of simplicity.

the slightest trace of either bromine or iodine could be detected.

This analysis is of interest as showing the large amount of saline matter which may exist in a water-weed. Parkes remarks in his "Manual of Hygiene" (p. 30), "It should also be remembered that some water plants have a purifying effect, apparently from the large amount of oxygen they give out: and this takes place sometimes though the water itself is green." It appears probable that aquatic plants possess not only the power of indirectly oxidising dissolved organic matter, but also of removing saline substances from water. When sewerage is placed on the ground, vegetation is encouraged in order to render animal matter innocuous, and there does not appear to be any valid reason why a similar procedure should not be applicable and equally beneficial in the case of contaminated water. The desirableness, therefore, of allowing water-weeds to grow freely in Indian tanks—which are always extremely liable to pollution—need hardly be urged.

But in order to derive benefit from aquatic plants, tanks should be cleaned periodically. The danger of permitting weeds to remain in water during the hot weather is alluded to by Drury ("Useful Plants of India"). He states that "in Jamaica the *Pistia stratiotes*, in the hot dry weather, impregnates the water with its particles to such a degree as to give rise to the bloody-flux." In the hot weather, when the volume of water in a tank is reduced through evaporation, &c., any contaminating material gaining access would be introduced into the system in a less diluted form than when the same tank was full. The object should therefore be to facilitate oxidation as much as possible.

The higher the temperature of the water the more rapid is oxidation likely to be, and a water in the hot weather freely exposed to the action of heat, light, and air, is less likely to retain deleterious organic matter in an active form than the same water covered with a layer of floating vegetation. In the cold weather, on the other hand, when tanks are full, the indirect oxidising power possessed by aquatic plants might be utilised to assist in the destruction of organic matter, and in the removal of inorganic salts which may have been washed into the water by rain-fall.

Bearing in mind the exposed condition of most Indian tanks, and the numberless sources of pollution to which they are exposed, it seems probable that it is only on such grounds that the absence of ill effects ensuing in then using the water can be explained. The mouths of wells, in most instances, are slightly raised above the level of the ground, so that, as a rule, contaminating matter has to filter through a certain depth of soil before reaching the water, and is there rendered innocuous, but when sewerage does gain direct entrance it appears to retain its toxic powers for a prolonged period, this being doubtless due to the low temperature of the water, and the more or less absence of light, aquatic plants, and stagnation of the air.

Medical College, January 24, 1883.

Royal Institution.—The following are the the arrangements for the Lectures after Easter:—Professor J. G. M'Kendrick, ten lectures on "Physiological Discovery;" Dr. Waldstein, four lectures on the "Art of Pheidias;" Professor Tyndall, three lectures on "Count Rumford, Originator of the Royal Institution;" Mr. R. S. Poole, three lectures on "Recent Discoveries in (1) Egypt, (2) Chaldæa and Assyria, (3) Cyprus and Asia Minor;" Mr. A. Geikie, six lectures on "Geographical Evolution;" and Professor C. E. Turner, four lectures on "Historical Sketches of Russian Social Life." The discourses on the Friday evenings will probably be given by Mr. A. Geikie, Dr. Waldstein, Professor B. Balfour, Mr. C. W. Siemens, Mr. R. A. Scott, and Professors Huxley, Turner, Flower, Pollock, and Dewar.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING FEBRUARY 28TH, 1883.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To the RIGHT HONOURABLE THE PRESIDENT OF THE
LOCAL GOVERNMENT BOARD.

March 5th, 1883.

SIR,—We submit herewith the results of our analyses of the 168 samples of water collected by us during the month of February, on the days and at the times indicated, from the mains of the seven London water companies taking their supply from the Thames and the Lea.

Of these 168 samples, two were recorded as slightly turbid, and five as very slightly turbid. The remainder were found to be bright, clear, and efficiently filtered.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from February 1st to February 28th inclusive. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water as determined by the colour-meter described in a previous report.

Of the 24 samples supplied by the New River Company, the whole were found to be well filtered, clear, and bright.

Of the 24 samples from the mains of the East London Company, the whole were found to be well filtered, clear, and bright.

Of the 24 samples from the mains of the Chelsea Water Company, one was recorded as "very slightly turbid." The remainder were found to be well filtered, clear, and bright.

Of the 24 samples from the mains of the West Middlesex Company, the whole were found to be well filtered, clear, and bright.

Of the 24 samples from the mains of the Lambeth Water Company, two were recorded as "very slightly turbid," the remaining 22 samples being well filtered, clear, and bright.

Of the 24 samples from the mains of the Grand Junction Company, six samples were recorded as "very slightly turbid," the remaining 18 samples being found well filtered, clear, and bright.

Of the 24 samples from the mains of the Southwark and Vauxhall Company, two were recorded as "very slightly turbid," the remaining 22 samples being found to be well filtered, clear, and bright.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples collected.

The proportion of organic matter found in the water has continued to be much the same as that observed during the previous month; although the maximum amount found in one particular sample taken in January has not since been met with. The condition of the water in respect to its freedom from turbidity has been noted in the preceding paragraphs.

We have the honour to remain, Sir,
Your obedient Servants,

WILLIAM CROOKES,
WILLIAM ODLING,
C. MEYMOTT TIDY.

ON THE
USE OF LITMUS, METHYL-ORANGE,
PHENACETOLIN, AND PHENOL-PHTHALEIN
AS INDICATORS.*

By ROBERT T. THOMSON.

(Concluded from p. 127).

XI. Effect of Silicate of Sodium.

A PRELIMINARY test was made of the value of litmus for the estimation of soda in silicate of sodium by taking a quantity of hydrate of sodium of known strength, dissolving some silicate in it, and then determining the soda. The exact amount of soda used was found, and the estimation made by litmus was taken as the standard of comparison with the results obtained with the other indicators. 5 grms. of commercial liquid silicate of soda were employed, and 15.05 c.c. of normal acid were consumed with litmus as indicator, the end-reaction taking place with great distinctness.

With *Methyl Orange*, also, a very distinct end-reaction was obtained, and 15.1 c.c. were consumed, a result closely corresponding with the former one.

Phenacetolin gives a dark pink colour with the silicate of sodium, but this became yellowish towards the end of the test, and the change was not very distinct. 15 c.c. of the acid were necessary, which does not materially differ from the quantities obtained with litmus and methyl-orange.

Phenol-phthalein.—The red colour produced by the phenol-phthalein was slowly destroyed on running the acid into the cold silicate solution, 12.7 c.c. only being required. When boiled, the colour returned, but was dispelled when 13.5 c.c. had been added. These results are considerably below the truth.

TABLE VIII.

Results obtained in the titration of silicate of sodium ($\text{Na}_2\text{Si}_4\text{O}_9$).

Name of Indicator.	C.c. Normal Acid consumed.	Grm. of Na_2O found.
Litmus	15.05	0.466
Methyl-orange	15.1	0.468
Phenacetolin	15.0	0.464
Phenol-phthalein (cold) ..	12.7	0.393
„ (boiled) ..	13.5	0.418

XII. Effect of Alumina.

Soluble alumina, like silica, is seldom or never absent from caustic soda or potash. The experiments were made with an excessive quantity of alumina, the proportion used being equal to about 8 per cent in an average strength caustic soda. A quantity of pure hydrate of aluminum, equal to 0.515 gm. Al_2O_3 , was prepared from alum by precipitation with ammonia. This precipitate was re-dissolved, re-precipitated, washed thoroughly, dissolved in 125 c.c. of normal caustic soda, and made up to 250 c.c. with water. 50 c.c. of this was employed for each test, and contained 0.775 gm. of soda, and 0.103 gm. of alumina.

Litmus.—When litmus was used 25.25 c.c. of the normal acid were consumed in place of 25 required when no alumina was present, nor did the end-reaction come out very distinctly.

Methyl-orange.—After a little more than 25 c.c. of the acid had been consumed, the alumina was all precipitated, and then gradually dissolved, the pink colour at first produced being quickly dispelled as the acid combined with the alumina. A decided and permanent change occurred when 30.7 c.c. had been added. This gives 0.951 gm. of soda as against 0.775 really present, and if the difference be calculated to alumina, it shows 0.097 gm. of the latter

compound instead of 0.103. It is thus evident that nearly the whole of the alumina has been estimated along with the soda.

With *Phenacetolin* and *Phenol-phthalein* the real amount of soda used was obtained. The only effect of the precipitated alumina is to obscure the end-reaction slightly.

TABLE IX.

Results obtained in the titration of aluminate of soda.

Na ₂ O used for each test	0.775 grm.	
Al ₂ O ₃ „ „ „	0.103 „	
= Na ₂ O „ „ „	0.186 „	
Name of Indicator.	C.c. of Normal Acid consumed.	Grm. of Na ₂ O found.
Litmus	25.25	0.782
Methyl-orange	30.7	0.951
Phenacetolin	25.05	0.776
Phenol-phthalein	25.0	0.775

XIII. Effect of Nitrite of Sodium and Potassium.

A solution of nitrite of potassium was prepared by decomposing with chloride of potassium a known weight of nitrite of silver, which was precipitated from a solution of nitrite of sodium. 20 c.c. of this nitrite of potassium liquor contained 1.7 gm. of KNO_2 , and this quantity diluted to 100 c.c. was employed for each test. The nitrite was found to be quite neutral to litmus, phenacetolin, and phenol-phthalein. With methyl-orange, however, the pink colour was not produced, even after adding 30 c.c. of normal acid, but seemed to be destroyed at once by the liberated nitrous acid. Another quantity containing 0.085 gm. of the nitrite in the 100 c.c. gave a pink colour with 0.2 c.c. of acid, but this was slowly dispelled on standing a few minutes, leaving a pale yellow colour. Nitrite of sodium acts in the same way towards the indicators as nitrite of potassium. Nitrites are sometimes found in small proportion in caustic soda and potash.

XIV. Determination of Soda in Borax.

The solution of borax employed contained 1.683 grms. of pyroborate of sodium in 50 c.c., the quantity used for each test.

With *Litmus* the blue colour began to purple when 13 c.c. had been added, but the change was not complete until 16.65 in the one case and 16.6 c.c. of normal acid in the other had been consumed. This shows 0.516 and 0.514 gm. of soda, as against 0.516 really present. The end-reaction, however, is very indistinct.

Methyl-orange is by far the best indicator for the estimation of soda in borax, and is, indeed, perfect in that respect. The change in colour at the end of the experiment was very sharply defined. The results agreed closely with those of litmus.

Phenacetolin.—Like litmus the colour of this indicator slowly changes, and a good end-reaction is therefore impossible. The whole of the soda can be estimated by it.

Phenol-phthalein is utterly useless for the purpose under consideration. The red colour disappears before half of the soda is determined in cold solutions. When boiled a much higher result is obtained, but still very far below the truth.

TABLE X.

Determination of Soda in Borax.

$\text{Na}_2\text{B}_4\text{O}_7$ used for each test		1.683
$=\text{Na}_2\text{O}$ " " "		0.516
Name of Indicator.	C.c. of Normal Acid consumed.	Grm. of Na_2O found.
Litmus	16.65—16.6	0.516—0.514
Methyl-orange.. .. .	16.7 —16.65	0.518—0.516
Phenacetolin	16.7 —16.6	0.518—0.514
Phenol-phthalein (cold)..	7.6 — 7.8	0.235—0.242
" (boiled)..	11.0 —11.3	0.341—0.350

* A Paper read before the Philosophical Society of Glasgow (Chemical Section), January 22, 1883.

XV. Determination of Free Sulphuric, Nitric, and Hydrochloric Acids.

It is quite plain, from the results obtained when testing the behaviour of the sulphates, chlorides, and nitrates of the alkalis with the indicators under consideration, that these acids can be determined by a standard caustic alkali, excepting that ammonia cannot be used with phenol-phthalein. Carbonate of sodium can be used in the cold if methyl-orange is employed, and in the case of phenacetolin the caustic potash or soda should contain a little carbonate of potassium or sodium, so that the carbonate or bicarbonate will be formed when the end-reaction is reached, and the dark pink colour will be produced.

XVI. Determination of Free Oxalic Acid.

A normal solution of pure oxalic acid was prepared, and 20 c.c. of this was employed for each test.

With *Litmus* the end-reaction was very well defined, and exactly 20 c.c. of normal hydrate of sodium were consumed, thus giving exactly the amount of oxalic acid.

Methyl-orange.—It has been pointed out by Lunge that methyl-orange must not be employed when oxalic acid is titrated, and from the following test it is evident that it cannot be relied on. When 12 c.c. of the normal alkali were added the pink colour began to fade away, and was completely destroyed after the addition of 18 c.c.

Phenacetolin.—The addition of 19.8 c.c. produced a very faint pink colour, which was not fully developed till 20 c.c. had been consumed. This indicator cannot, therefore, be recommended as useful for the titration of oxalic acid.

Phenol-phthalein, on the contrary, works admirably, the end-reaction being as delicate as with the mineral acids. The result agreed with that of litmus.

TABLE XI.

Determination of Oxalic Acid.

H ₂ C ₂ O ₄ used for each test			0.900 grm.
Name of Indicator.	C.c. of Normal NaHO consumed.	Grm. H ₂ C ₂ O ₄ found.	
Litmus	20.0	0.900	
Methyl-orange ..	18.0	0.810	
Phenacetolin ..	19.8	0.891	
Phenol-phthalein ..	20.0	0.900	

XVII. Determination of Acetic Acid.

The sample of acetic acid in which the free acid was determined showed a specific gravity of 1.0472 at 15° C., which is equal to, according to Oudemans' table, 35.02 per cent of HC₂H₃O₂. 100 grms. of this acid were made up to 1 litre with water, and 50 c.c. used for each titration, the caustic alkali used being standardised with normal sulphuric acid.

Litmus.—On adding the normal caustic soda the red colour remained intact, but towards the end of the experiment became purple, and almost blue before the end-reaction was accomplished. The last change in colour could only be observed by comparison with a blue litmus solution of the same strength as the liquid operated upon. 29.15 c.c. were consumed both with this experiment and with one tested with litmus paper, 1.749 grm. of acetic acid being obtained in each case.

Methyl-Orange is totally useless as an indicator in the estimation of acetic acid, only 3.5 c.c. of the alkali being consumed.

Phenacetolin.—The addition of 28 c.c. produced a pale rose-colour, but the change was very undecided. This indicator is not adapted for this purpose.

Phenol-phthalein is well fitted for use in the estimation of free acetic acid by caustic soda, as acetate of sodium is perfectly neutral to it, while that salt is alkaline to litmus. Several tests gave 29.2 c.c. of normal alkali consumed, these results being slightly, but quite distinctly, higher than those obtained with litmus. The end-reaction is as delicate and sharply defined as in the determination of the mineral acids. If the solution in which the acetic

acid is to be determined is dark-coloured (as in some vinegars) it may be highly diluted, as dilution has little or no effect on the delicacy of phenol-phthalein.

TABLE XII.

Determination of Acetic Acid.

Name of Indicator.	C.c. of Normal NaHO consumed.	Grms. of HC ₂ H ₃ O ₂ found.
Litmus	29.15—29.15	1.749—1.749
Methyl-orange ..	3.5	2.10
Phenacetolin ..	27.8	1.668
Phenol-phthalein.	29.2 —29.2	1.752—1.752

XVIII. Determination of Tartaric Acid.

1.5 grms. of pure and dry tartaric acid were used for each experiment. The solution tested with litmus as indicator began to get purple after the addition of 19 c.c. of normal caustic soda, but the change to blue was not complete till 20 c.c. had been consumed, the tartaric acid found being exactly equivalent to the quantity taken. As with oxalic and acetic acids, *Methyl-orange* gives very low results, 16 c.c. only being required to dispel the pink colour. The tartaric acid found by *Phenacetolin* was slightly but perceptibly under the truth. *Phenol-phthalein* in this case, as with acetic acid, is the only perfect indicator among these four. Although the results obtained are much the same as those with *Litmus*, the unimpaired delicacy of the end-reactions gives *Phenol-phthalein* a great advantage over the former indicator.

TABLE XIII.

Determination of Tartaric Acid, H₂C₄H₄O₆, used for each test 1.5 grms.

Name of Indicator.	C.c. of Normal NaHO consumed.	Grms. of H ₂ C ₄ H ₄ O ₆ found.
Litmus	20.00—20.00	1.500—1.500
Methyl-orange ..	16.00	1.200
Phenacetolin ..	19.85	1.488
Phenol-phthalein.	20.00—20.00	1.500—1.500

XIX. Determination of Citric Acid.

The sample used for the following tests was found to be free from impurity, but, as the water of crystallisation varies to some extent, it was determined by drying for about twelve hours between 50° and 60° C., and then gradually raising the temperature to 100°. 8.53 per cent was obtained, which is slightly lower than the theoretical proportion of 8.57 per cent. As 14 grms. were made up to 200 c.c., 20 c.c. contained 1.2806 grms. of dry citric acid (H₃C₆H₅O₇), this being the quantity operated upon. The normal caustic soda was standardised by normal sulphuric acid.

Litmus seems still to be considered the best indicator for the estimation of free citric acid, but it is a very defective one. In the first place it gives a very indefinite end-reaction, and in the second the normal citrate of soda formed during titration is so alkaline as to preclude the use of sulphuric or any other mineral acid in the standardising of the caustic soda. Pure citric acid must in that case be employed as the standard, and this entails the testing for impurities and the tedious estimation of water described above. Allen, in his "Commercial Organic Analysis" (vol. i., p. 263), noticing these points, observes that neither logwood nor cochineal gives sharp end-reactions, and recommends the use of carefully-prepared litmus paper. In the two tests I made both litmus solution and paper were used, the last change in colour of the former being observed by placing it side by side with a litmus solution of equal strength, to which a little alkali had been added. The results were identical, 19.7 c.c. of the normal alkali being consumed in each case. This shows 0.92 grm. too little of citric acid, and is to be attributed to the alkalinity of the citrate, as sulphuric acid was made use of in testing the standard caustic soda.

Methyl-orange and *Phenacetolin* were found to be of no value in the titration of citric acid, 9 c.c. being consumed with the former and 17 with the latter.

Phenol-phthalein.—This indicator is again distinguished from the others by its great delicacy in the determination of free citric acid, as it is in that of tartaric and acetic acids. Several tests were made, and in every case 20 c.c. of the normal acid were consumed, giving results extremely close to the real amount of citric acid present. *Phenol-phthalein* has thus two advantages over litmus for the determination of citric, tartaric, and acetic acids:—1st, it gives a sharply defined end-reaction; and 2nd, sulphuric acid can be employed in standardising the caustic soda.

TABLE XIV.

Determination of Citric Acid, Sulphuric Acid being used for the Standardising of the normal Caustic Soda.

$H_3C_6H_5O_7$ used for each test . . . 1.2806 grms.

Name of Indicator.	C.c. of Normal NaHO consumed.	Grm. of $H_3C_6H_5O_7$ found.
Litmus.. . .	19.7—19.7	1.2608—1.2608
Methyl-orange ..	9.0	0.5760
Phenacetolin ..	17.2	1.1000
Phenol-phthalein .	20.0—20.0	1.2800—1.2800

Litmus and phenol-phthalein were further tested with a sample of lime-juice, in order to make certain that a similar difference in result would be brought out when these indicators were applied to the determination of citric acid in this substance. Of course the other free acids existing in the juice would be included in the result. 10 c.c. of the sample measured at 15.5° C. were employed.

Litmus Paper was used as indicator, as the yellow colouring-matter of the lime-juice darkens so much as to make litmus solution useless. 13.0 and 13.05 c.c. of normal alkali were consumed, which give 36.5 grains of dry citric acid per ounce, 30 grains per ounce being the Board of Trade standard.

Phenol-phthalein.—With this indicator the most convenient quantity to use is 10 c.c. of the juice diluted to 150 or 200 c.c. As the yellow colouring-matter becomes darker towards the end of the experiment, the end-reaction is not quite so delicate as in a colourless solution, but can still be recognised without the least difficulty. 13.25 c.c. of the normal alkali were consumed in each case, these results being equal to 37.1 grains of dry citric acid per ounce.

TABLE XV.

Determination of Free Acids in Lime-Juice.
10 c.c. of sample used for each test.

Name of Indicator.	C.c. of Normal NaHO consumed.	Grains of $H_3C_6H_5O_7$ per ounce.
Litmus.. . .	13.00—13.05	36.40—36.54
Phenol-phthalein .	13.25—13.25	37.10—37.10

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 15, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

The following certificates were read for the first time:—T. L. Briggs, E. C. Conrad, C. Gillett, L. Levy, A. Ness, V. I. Schopoff, A. E. Wilson.

Dr. GILBERT announced that the Anniversary Meeting would take place on Friday, March 30, and that he had decided, after much deliberation, to resign the office of President. The Council proposed that Dr. W. H. Perkin

should fill the vacancy thus created, and that Mr. J. Millar Thomson should be Secretary.

Mr. T. MATTHEWS then read a paper "*On Some Condensation-Products of Aldehyds with Aceto-acetic Ether and with Substituted Aceto-acetic Ethers*." The author has studied the following reactions:—Condensations of acetic ether with isobutylic aldehyd, with valeric aldehyd, with chloral, with furfural, and with acrolein; of benzoic aldehyd with aceto-diethyl-acetic ether, with aceto-dichlor-acetic ether, with aceto-benzyliden-acetic ether, and with aceto-monoethyl-acetic ether. He concludes that aceto-acetic ether is capable of condensing with aldehyds of all descriptions, and that the condensation takes place only in the methylen group, but with the greatest ease; that mono- and di-substituted aceto-acetic ethers, with the exception of the dichlor ether, are capable of condensing with benzoic aldehyd, but the condensation is much more difficult to effect, and it takes place only in the methyl group.

Mr. R. WARINGTON communicated a paper entitled "*Contribution to the Chemistry of 'Fairy Rings,'*" by Sir J. B. LAWES, J. H. GILBERT, and R. WARINGTON. The circles of dark green grass which frequently occur on pasture-land, and which have been long known by the name of "Fairy Rings," have attracted much attention from botanists and vegetable physiologists. Prof. Way in 1846 explained this phenomenon as follows:—"A fungus is developed on a single spot of ground, sheds its seed, and dies. On the spot where it grew it leaves a valuable manuring of phosphoric acid and alkalies, &c.: the ground then becomes occupied by a vigorous crop of grass, rising like a phoenix on the ashes of its predecessor. The grass crop is then removed, and with it the greater part of the inorganic materials the fungus had collected." Prof. Way therefore attributed the effect chiefly to the inorganic elements. Many experiments were made on the subject at Rothamsted, and in 1851 (*Four. Roy. Agr. Soc.*, vol. xii., p. 32) it was stated that the manuring action was due to the nitrogen collected by the fungus rather than to the ash constituents. The source of the nitrogen was at that time supposed to be the atmosphere. Since that time, however, much evidence has been acquired as to the sources of the nitrogen of green-leaved plants, and grave doubts have arisen as to the nitrogen being derived from the atmosphere. In 1874 an attempt was made to obtain direct experimental data on the subject. Samples of soil were taken of the soil, inside a fairy ring, from the ring, and outside. The organic carbon and nitrogen were carefully estimated. The mean results obtained were:—Nitrogen within the ring, 0.247 per cent; on the ring, 0.266 per cent; outside, 0.281 per cent. Carbon within, 2.78 per cent; on the ring, 2.99 per cent; outside, 3.30 per cent. The percentage of nitrogen and carbon is therefore highest in the soil outside the ring, and lowest within the ring, whilst the quantities found in the soil from the ring have an intermediate value: it is obvious, therefore, that the growth of the fungus, and the subsequent increased growth and removal of the associated herbage, is accompanied by a considerable reduction in the amount of the organic carbon and nitrogen in the soil, or that fungi have taken up organic carbon and nitrogen from the soil which was not available to the previously established vegetation. Five series of experiments were made, and the investigation would have been continued, but, owing probably to the late wet seasons, the fairy rings have disappeared from Rothamsted. The soil of the ring always contained more nitrates than the soil either within or without.

Dr. GILBERT said that the point of interest in the paper was the source of the nitrogen. These rings usually occurred on very poor pastures, and it was at first natural to suppose that the fungi must draw the nitrogen from another source, as the previous vegetation could not obtain it from the soil; and although we have no evidence that green-leaved plants can obtain nitrogen from the atmosphere, it was thought that with fungi, whose growth is so

different, it might be otherwise. Direct evidence that the nitrogen comes from the soil is still wanting, but there is a great deal less evidence that the nitrogen is furnished by the atmosphere, so that on the whole the balance of evidence points to the soil as the source of the nitrogen.

The SECRETARY then read a paper "*On Lines of no Chemical Change*," by E. J. MILLS and W. McD. MACKAY. The authors considered it of great interest to determine in certain cases the origin of chemical change, such origin being obviously identifiable in many instances with a line of no chemical change. In the present paper they have studied the reaction between sulphuric acid and zinc brought in contact under definite conditions as regards temperature, strength of acid, &c. The hydrogen evolved was taken as the index of the extent of the reaction. The results are contained in tables, and are plotted on a curve. The nature of the reaction is shown to be of a very complicated character. The law of the relation of temperature to chemical change requires an equation of the second degree. The authors state that their investigations place temperature on the footing of an ordinary chemical reagent. They intend to resume this investigation.

The SECRETARY then read a paper "*On Homologous Spectra*," by W. N. HARTLEY. In June 1881, the author published (*Journ. Chem. Soc.*, 134, 84) a note on certain photographs of the ultra-violet spectra of elementary bodies, and attention was directed to the extraordinary similarity between the groupings of lines in the spectra of magnesium, zinc, and cadmium, copper and silver, iron, cobalt, and nickel. It was thus made evident that the spectra of elements of the same homologous series present either homologous spectra or homologous groups of lines in their spectra; but it was remarked, "it will be hopeless to determine whether there are numerical relations between the wave-lengths of different groups of lines until the spectra have been reproduced on an enlarged scale, and the wave-lengths for the principal lines of the different elements calculated." Ciamician has remarked that almost every element has a number of feeble lines which bear the same relation to the chief line or lines that the overtones in music bear to the fundamental note. These observations, however, refer only to the visible rays, or about one octave of the spectrum; photographs of the ultra-violet region can easily be extended to more than two octaves. The conclusions of Ciamician are completely confirmed by such extended photographs. The three hydrogen lines, *H*, *F*, and *C*, have been shown to be the 32nd, 27th, and 20th harmonics of a fundamental vibration whose wave-length is 0.01313 m.m. There is evidently a harmonic relation between the lines in the spectra of magnesium, zinc, cadmium, aluminium, and in those of calcium, strontium, and barium, when two octaves of the spectra are examined. The fundamental vibrations appear to be all in the infra-red region. The author originally intended to bring forward an extended series of observations on the constitution of the spectra of the elements, but as it appears that Liveing and Dewar are engaged in a similar research, the author wishes to publish such facts as he has already obtained. In order that harmonic relations between lines and groups of lines may be rendered apparent it is necessary to map spectra according to their "oscillation-frequencies" instead of wave-lengths. The author has thus mapped the wave-frequencies in one millimetre of the chief rays in the spectra of magnesium, zinc, cadmium, copper, silver, silicon, boron, and aluminium. The data thus obtained present a considerable addition to the body of evidence in support of the view that elements, whose atomic weights differ by a constant quantity and whose chemical character is similar, are truly homologues, or in other words are the same kind of matter in different states of condensation. The probability of the fundamental vibrations of the simpler elements being found in the infra red region will doubtless be soon tested, since Capt. Abney has enabled us to photograph this region, and with the help of Rowland's exquisite concave

ruled specula, we have now a range of four octaves of the spectrum.

The Society then adjourned to April 5, when a paper "On the Estimation of Hydrogen Sulphide and Carbonic Anhydride in Coal gas," by L. F. Wright, will be read.

The Anniversary Meeting is on Friday, March 30.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 20, 1883.

H. E. ROSCOE, Ph.D., LL.D., F.R.S., &c., President, in the Chair.

A COMMUNICATION from Dr. JOULE, F.R.S., was read, on the use of lime as a purifier of the products of combustion of coal-gas.

The slaked lime is placed in a vessel, the bottom of which, about one foot diameter, is slightly domed and perforated with fine holes. The vessel is suspended about 6 inches above the burner. It is found that a stratum of 4 or 5 inches of lime is sufficient to remove the acid vapours so far as to prevent them from reddening litmus-paper. The lime seems in many respects to present important advantages over the zinc previously recommended.

Mr. R. D. DARBISHIRE, F.G.S., read a "*Note upon the Mammoth Cave*," by Mr. G. DARBISHIRE.

After leaving the old "blue grass" formation* to the east and crossing the Louisville rocks, one approaches the dry lands of the "sub-carboniferous formations."†

Here the rainfall is carried off by "sink-holes," and, except where important streams flow in open gorges 300 to 350 feet below the plain, the drainage is all underground. Sink-holes are sometimes isolated funnels in the middle of depressions which might still hold lakes unless so drained, and probably did so once, and sometimes are the outlets at the bottom of dry ravines which have no mouths. The water entering these sink-holes passes away through cracks and caverns hollowed out of the weaker places in the rocks. When such a cavern channel is formed near the surface the roof falls in at places, and a more or less open ravine appears. At times the sink-holes, after using an upper series of caverns for ages, have drilled downwards by means of the gravel and rock churning in the bottoms of pot-holes till the water has found lower outlets, and when it has eaten out on lower levels waterways sufficient for the rainfall of the district, the upper caverns are deserted, the muds washed in harden on the floor, and pieces of the roof becoming detached, partially fill the unused ways with *débris*. As

* "The cultivated district of central Kentucky, commonly known as Blue-grass District, is perhaps for its area the most beautiful rural district in America. The surface is undulating, large areas of the original forests have been cleared of their undergrowth, and produce a fine close sod, and in these wood-pastures are some of the finest flocks and herds in the world. It has happened to the writer to pass on several occasions from this region to the richest lands of middle England, or *vice versa*, and he has always been struck by the singular likeness of the two countries. There is probably a closer resemblance between the surface of the country, the cattle, horses, the agriculture, and even the people of these two areas than any two equally remote regions of the world"—From General Account of the Commonwealth of Kentucky ("Geological Survey"), vol. ii., p. xi.

† All this region wants the small valleys which we are accustomed to see in any country; but in their place the surface is covered by broad, shallow, cup-like depressions or sink-holes, in the centre of which is a tube leading down to the caverns below. All this region is completely honeycombed by caverns, one level below the other, from the surface to the plane of the stream below. In one sense this set of underground passages may be regarded as a continuous cavern as extensive as the ordinary branches of a stream when it flows upon the surface. The sink-holes answer to the smallest extremities of the branches. Some idea of the magnitude of these underground ways may be formed by the fact that the Mammoth Cave affords over 200 miles of chambers large enough for the passage of man, while the country in which it occurs has over 500 openings leading far into the earth, none being counted where it is not possible to penetrate beyond the light of day.

this goes on, stalactitic and florescent stalagmitic formations accumulate in these stormless old river channels. The sign of water action in the rocks is wonderfully preserved, and tells its tale of stream-wear or drift-wear more faithfully than in valleys exposed to rains, vegetation, and changes of temperature. The unaccustomed darkness and the strange shadows cast by the lamps of visitors give to these accumulations, masses of *débris*, and water-worn roofs and walls, weird shapes which are fancifully supposed to resemble familiar objects above ground. Their own individualities, so different from anything on the surface, give them a far stronger claim on the observer's interest.

Amid slightly undulating woodlands, about 325 feet above Green River, lies a depression some 80 feet deep, and at one place the sandstone bottom of this depression has fallen away, exposing an opening into the "Mammoth Cave," whose upper and lower chambers are known to extend for 200 miles, and to communicate with further unexplored channels.

After a descent from the open air of about 60 feet the floor of the "Water Cave" is reached. This has been dry as long as it has been known. Indeed, as it is nearly 200 feet above Green River (the drainage level in this district), the water must for ages have been able to traverse large lower channels.

The old deposits of mud in these upper caves have been so saturated with saltpetre that they have been washed as early as the war of 1812. On the theory that this saltpetre is derived from bat-guano, acted on by the dry atmosphere of the cave, a long period of inaction as a river channel must be allowed for. The number of bats is certainly great, but their lease of the premises during which nitre has been thus accumulated must have been a long one.

For convenience of tourists and guides the caverns are usually visited by what are called the *short* or the *long* routes, about $3\frac{1}{2}$ and 8 miles long respectively. The short route leads for a considerable distance through the main cave amid the workings of the saltpetre diggings. This main cave, nearly 4 miles in length, has an average width of 60 feet and a height of 40 feet above the present floor, which is formed of *débris* and alluvial deposits considerably deep over the real rock floor. Owing to peculiar causes in this dry cave the earth has hardened, and in places the guide points out footprints of the oxen used by the miners not earlier than the beginning of the century, in clay now nearly as hard as rock. The corn-cobs used long ago are still undecayed.

The short route leads visitors from the main cave down by a broken opening to a lower range of caverns in the limestone. These, after passing through various chambers and galleries, lead to a series of "domes and potholes." The "domes," or portions of the potholes extending upwards, are no doubt connected with the funnels of some slough-like depressions in the ground above, and have supplied water to the various levels of caverns in their turn, while the holes, having bored some 65 feet lower down, open into the present drainage avenues below. The vertical height of these shafts as visible at present is from 200 to 230 feet, and their diameter about 25 feet, a size due to the cutting power of the gravels in the pothole, and far in excess of anything required by the volume of water to be removed.

On the long route, after leaving the main cave and descending to the "deserted chambers," a second descent leads to the third series of caves, also dry in the present age. Presently the track sounds hollow, and at places, openings in the floor reveal a fourth series of chambers. Descending to these, one reaches the level of medium high-water mark. A descent of 30 feet brought us to the water, which, on 1st of November, after the protracted drought, was about 300 feet below the Hotel by my aneroid, or 24 feet above Green River. Here then is reached a cave that is still in use, and the roof shows that these caverns are often quite filled with water.

After crossing several pools, the Echo River is reached, showing a slight current on its surface. The depth of this stream varies from 5 to 10 feet, and its width is from 20 to 200 feet, but probably the deeper parts are nearly still pools. Rowing along this for three quarters of a mile, avenues are next traversed which for a long distance show the mechanical and chemical erosions of the water-flow, and chambers are reached where the roofs and sides are covered with florescent formations of gypsum, the long fibrous bunches of crystal curving outwards from some centre, forming delicate rosettes from one to six inches in diameter, and as beautiful as flower-like sea anemones; but, unfettered by the bonds of species, every variety of form appears, white, yellow, or black, and all adorned with glittering crystals.

At last, after a scramble over *débris* (called "the Rocky Mountains," which has piled up to a height of 200 feet above the water, or a little above the top of the entrance of the main cave, the roof is seen to change. It is above the limestone, and the naked sandstone stretches from side to side. A little further on "the Maelström" is reached, another huge pothole, in which the gravels at the bottom are but little above the present water-level, while the dome reaches far up into the sandstone.

On the return journey, a short cut is made up what is called "the Corkscrew." In reality it is a scramble up a cleft in the rocks nearly choked by *débris*, the top of which is also very near the sandstone. To give an idea of the vastness of this underground drainage I copy from the Guide Book a few dimensions relating to this one cave, and be it remembered that the whole country from Bowling Green to Mufordsville is similarly honeycombed.

The chamber called "Wright's Rotunda" is 400 feet one way and 100 feet wide, while its height is 40 feet.

Mammoth Dome, of a similar length, has a roof of 150 feet span, in the sandstone, and its depth from the bottom of the superincumbent sandstone to the floor is 250 feet.

NOTICES OF BOOKS.

Taschenbuch für die Soda, Pottasche, und Ammoniak Fabrikation. (Pocket Book for the Manufacture of Soda, Potash, and Ammonia). Von Dr. G. LUNGE. Berlin: Julius Springer.

WE have here a book of reference calculated to prove exceedingly useful to a numerous and important class of chemical manufacturers. The author sets out with the intention of supplying a general unity and agreement in the analytical methods used in chemical manufactories, as well as in the atomic weights, tables for reduction, and other numerical constants. The calculations of molecular weights, of percentage compositions, analytical factors, &c., have been carefully verified for the purpose of eliminating errors which in some cases have found their way from one text-book to another. We may venture to say that the value of these re-calculations will, as the work becomes known, find recognition in industrial and technical laboratories.

The work consists of two main portions, the general and the special. In the former we find firstly a table of the atomic weight, the equivalents, and the atomicity of the elements, round numbers being mostly aimed at. We note that the author retains the old atomic weight for platinum (197.18) in preference to 194.46 as established by Seubert, on the ground that the former is universally accepted by the German potash-trade, just as in England the old atomic weight of sodium (24) has been so long maintained in opposition to the true figure. Next follows an exceedingly useful table showing in six parallel columns the molecular formulæ, molecular weights, equivalent formulæ, and weights and percentage composition of 162 compounds, including those most extensively used in manufactures and in analytical operations.

Then follow tables for calculating the results of gravimetric analyses on the same principle as those inserted in "Rose's Quantitative Analysis."

Next we have the solubilities of a number of compounds in cold and in boiling water, and of some of the more common and important salts in water at temperatures ranging from 0° or lower to 100° , and in some cases upwards. We then find Bunsen's table of the solubility of gases at a pressure of 760 m.m., and that of a number of gases at the same pressure, but at a range of temperatures. Then follow the specific gravities of solids, of liquids, the specific gravities and percentages of saturated saline solutions, the volume-weights of gases and vapours, the linear expansion of a number of bodies from 0° to 100° , tables for the conversion of the three thermometer scales, melting-points, boiling-points, tables for the reduction of the volumes of gases to normal temperature and pressure, the volumes of water at different temperatures, the reduction of water-pressure to mercurial pressure, tension of watery vapour, boiling-points of water at different barometric pressures. Next come a set of mathematical tables showing the circumferences and areas of circles, squares, cubes, square and cube-roots, measurements of certain surfaces and solids, measures and weights of different countries, different values of "horse-power," which appear to range from 474.53 to 600.85 foot-pounds, and values of coins.

Then we come to an abstract of the two laws most important in an industrial sense,—the patent-law (German), and the responsibility of manufacturers for accidents happening to their workmen. We cannot help remarking that the German patent-law contains some provisions which might be usefully introduced into our English system.

The "special" portion of the work is chiefly devoted to the analytical methods needful in examining raw materials, intermediate and finished products, residues, &c. The author has made it his object to select processes sufficiently simple and expeditious for industrial purposes, and at the same time, practically speaking, accurate. Where necessary, the apparatus used is plainly figured.

Under the determination of sulphur in pyrites we note that Dr. Lunge recommends Rieckmann's filter-paper as preferable to Swedish for the filtration of barium sulphate. In speaking of copper pyrites he remarks that the electrolytic method for the determination of the copper has not yet been adopted in copper works, as it has not been found practicable to obtain the copper sufficiently pure by a single precipitation. He recommends the precipitation of the copper as sulphide, with certain precautions, and the ignition of the precipitate, mixed with pure sulphur in a current of hydrogen or coal-gas.

Under sulphuric acid is a table of its specific gravities, with the corresponding degrees of Twaddell and Baumé, at 15° C., and another table, giving the reduction of the specific gravity of sulphuric acid of different strengths to other temperatures, its freezing-points, boiling-points, also the specific gravity and percentage of fuming sulphuric acid at different temperatures; a table for determining the nitrous acid in nitriferous chamber-acids, &c.; examination of the acid for traces of nitrogen-acids (for which Dr. Lunge utilises the splendid blue colouration produced by the addition of diphenylamine dissolved in 100 parts of pure sulphuric acid), lead, iron, and the analysis of fuming acid and of sulphuric anhydride.

Under the manufacture of chloride of lime we find methods for the analysis of natural pyrolusite, of the regenerated manganese and mud of the Weldon process, of chloride of lime, and of the gases obtained by the Deacon process.

An appendix contains instructions for taking samples of ores, minerals, and chemical products,—an operation often sadly mismanaged to the no small injury of the reputation of the unfortunate analyst.

As a convenient and accurate book of reference for all chemists connected with the alkali-manufacture and its associated branches this work is certainly unequalled. It

presents in a pocket form information which would require to be sought up from a number of authorities, and with great loss of time. We may add that the paper is good, and the type, though necessarily small, is exceedingly clear.

The Philosophy of Advertising, and Newspaper Register for 1883. By HENRY SELL. London: Sell's Advertising Offices.

THE author of this work strongly urges upon men of business the policy of advertising, and as decidedly recommends them to do it not directly but through the intervention of an agent. He maintains that incidental advertising is of little value, the results of £500 spent in a year's advertising will be more than double as great as (those of) £250, &c. He maintains that "each paper pays better as it is backed up by other advertisements in other papers," and he refers to "the extraordinary successful result of advertising in religious papers." This result, which we do not dispute, springs doubtless from the very questionable opinion entertained by the many that an advertisement which appears in a religious paper cannot be untrustworthy! The author very judiciously remarks that "advertisements in class papers are always amply repaid." In all cases of articles which appeal to some one class, a paper of relatively small sale read exclusively by that class is more valuable than an ordinary paper of immense circulation. Hence we scarcely appreciate the author's omission of many magazines from his list on the grounds that "some publications do not take advertisements, and others are, for various reasons, useless to advertisers." We doubt whether this latter verdict can justly be passed upon all that are omitted from his list. We find the *Telegraphic Journal*, now published weekly, figuring among the monthlies. *Longman's Magazine*, which has a large advertising connection, does not appear at all. Taken as a whole, Mr. Sell's book will prove of great value to all inclined to advertise.

CORRESPONDENCE.

THE COLOUR OF THE CYANOGEN FLAME.

To the Editor of the Chemical News.

SIR,—The experiment of the burning of cyanogen in air is perhaps one of the most beautiful in chemistry, and the observer may well hesitate before attempting to describe in words the splendid tints of the flame produced; but if the attempt is made, some approach to accuracy of description is desirable. The flame of cyanogen burning in air has been variously called purple (Brande, Turner, Graham, Regnault, Williamson, Roscoe, Harcourt and Madan, and Thorpe), purplish-blue (Thomson), bluish, mixed with purple (Ure), bluish, purple on the edges (Gerhardt), purple on the edges (Wurtz), purple-mantled (Roscoe and Schorlemmer), purple or peach-blossom coloured (Fownes), peach-blossom coloured (Watts), pale red (Fyfe), rose-edged purple (Miller), rose-red (Odling), violet (Armstrong), pink, edged with green (Bloxam), and pink or purplish, edged with yellow (Gregory).

In 1848 the late Professor John William Draper submitted the flame of cyanogen to a critical examination. He first, by the aid of a prism, examined the flame as a whole and mapped out its spectrum; and then, by an ingenious arrangement, examined the flame in detail, and found that for every band in the spectrum there was a zone of similar colour in the flame. Draper next sought to intensify the combustion of the cyanogen by burning it in oxygen in place of in air. As he anticipated, the flame increased in brilliancy, losing its delicate tints of pink and green and assuming a bright yellowish-white.

If carefully dried cyanogen, prepared from pure cyanide of silver, be burnt at a platinum jet it is possible by careful observation with the unaided eye to detect between the apex of the innermost zone of pale rose-lilac and the zone of pea-green, a zone of bright chrome-yellow, and outside, and enveloping all, a mantle of dark indigo-blue. It is a pretty experiment, while the cyanogen flame is being watched, to gently and gradually heat the platinum tube through which the gas passes, and at the end of which is the jet where the gas burns. The tints of rose-lilac and green and blue slowly fade and blend with a yellowish-white which seems to grow up in their midst. On slowly withdrawing the heat the yellowish-white softens and changes again to the rose-lilac and green and blue.

If cyanogen be burnt in a tube through which a current of pure dry oxygen is urged the colour of the flame may be made to change rhythmically from rose and green to yellowish-white by altering the relative rate of flow of the gases.

The experiment of altering the colour of the flame of cyanogen by raising the intensity of combustion has been performed in another way by Morren. With a Frenchman's enthusiasm he thus describes his experiment:—

"Si on fait brûler le cyanogène au moyen du chalumeau à deux courants, en faisant arriver au centre de la flamme du cyanogène un courant d'oxygène très pur (cette condition est indispensable) on voit se produire un des plus beaux effets de combustion possible, et cette expérience est certainement une des plus magnifiques qu'on puisse réaliser sur la combustion des gaz. Il se produit, au milieu de la flamme rosé-violetâtre du cyanogène, une boule d'un blanc vert éblouissant qui rappelle la lumière électrique produite par le courant de la pile entre deux charbons de cornue."

Plücker and Hittorf, speaking in more prosaic language, say:—

"When a jet of cyanogen mixed with oxygen is kindled, in the interior part of the flame a most brilliant cone of a whitish-violet light is seen, the limit between the ignited and the cold part of the jet:" and again, if "jets of the two gases meet from opposite sides [they form], if kindled, a brilliant flat vertical surface."

An instructive variation of the experiment of burning cyanogen in air is to cause the flame, by increase of pressure, to detach and maintain itself at a distance from the jet. A pillar of gas is obtained with a pointed head on which fits an envelope of air. Where the pointed head of the pillar rests against the surrounding air combustion takes place, and the red interior surface where the combustion is least intense and the temperature lowest can be clearly distinguished from the outer green or blue surface where the combustion is most intense and the temperature highest.—I am, &c.,

ALFRED W. SOWARD.

5, Serjeant's Inn, Fleet Street, E.C.

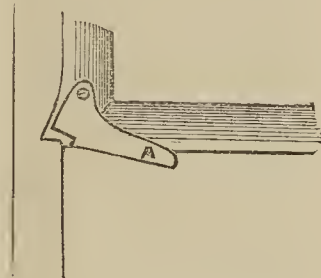
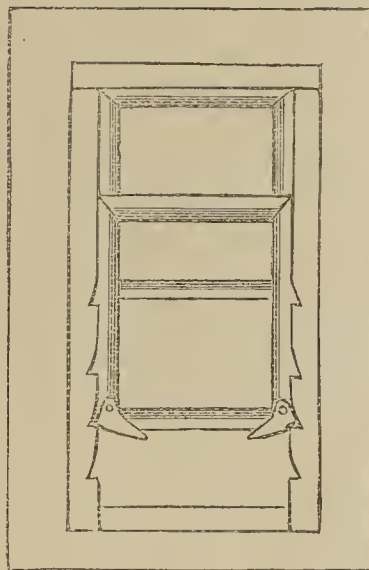
FUME CLOSETS.

To the Editor of the Chemical News.

SIR,—The balance-weights and springs commonly used for the openings of these are a dangerous nuisance, and accidents are constantly occurring. The arrangement I have had in use for several years has now been copied in several laboratories, and has proved so perfectly satisfactory, that a description will no doubt be acceptable to many. The window slides easily upwards, and by preference inside the upper part. On each side is a loose catch of hard wood, preferably boxwood, so shaped that by its own weight it drops into a recess cut in the frame carrying the window. When lifted to any height the catches drop in the nearest recess, and to release them it is simply necessary to take hold of the projections at the point marked A, these projections forming handles by which the window is lowered. It is advisable to have

one on each side in case either sticks from dirt or any other cause, although for all practical purposes one is sufficient.

This arrangement has been in daily use for many years without the slightest slip or accident of any kind, whereas, with the balance-weights and springs used previously it



Full size of catch, 4 inches.
(Scale, $\frac{1}{8}$ in. to the inch).

was necessary to replace these every few months, and even with every care accidents occurred frequently owing to the rapid and sometimes unexpected destruction of cords or springs by corrosive vapours.—I am, &c.,

THOS. FLETCHER.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 9, February 26, 1883.

Results of a New Series of Experiments on the Appliances for the Transport of Mechanical Energy fitted up on the Northern Railway of France by M. Deprez.—M. Tresca.—An account of experiments made on February 18. The author concludes that a maximum of 50 per cent of the energy generated may be transmitted if certain sources of loss can be corrected.

Formation-Heat of Chromic Acid.—M. Berthelot.—A thermo-chemical paper, not admitting of useful abstraction.

Researches on the Distribution of Dissolved Acids and Bases by the Method of Congelation of the Solvents.—F. M. Raoult.—The general law of the congelation of solvents (*Comptes Rendus*, November 27, 1882) presents, as far as water is concerned, a certain number of anomalies. The author seeks to utilise these in order to find out in what manner a base is shared between two acids, or an acid between two bases. He supposes the case when hydrochloric acid acts upon sodium acetate in equivalent quantities in presence of much water. He finds here that 95 per cent of the acetic acid is set at liberty.

Production of Brominised Apatites and Wagnerites with a Calcium Base.—A. Ditte.—The author has obtained products analogous to wagnerite and apatite in which bromine or iodine is present in place of chlorine, such as calcium bromo-phosphate, brom-arsenate, and bromo-vanadate.

Researches on the Action of Zinc-ethyl upon the Amines and the Phosphines.—H. Gal.—On causing zinc-ethyl to react upon an ammoniacal derivative in which all the hydrogen is not replaced, we obtain a metallic derivative, whilst ethyl hydride is evolved. With phosphuretted bases the result is similar. These reactions are in general very energetic, and it is well to moderate them by employing the zinc-ethyl in ethereal solution. Zinc-ethyl is without action upon tertiary amines and phosphines. Hence we have a new method for determining to which class an amine belongs. It is sufficient to place in test-tubes a small quantity of the different bases, and to pour upon each of them a small quantity of an ethereal solution of zinc-ethyl. In the tubes containing a tertiary amine there is no reaction, whilst in the others there is the regular and abundant development of a combustible gas, which is ethyl-hydride. The author has then examined the action of zinc-ethyl upon the natural alkaloids. With nicotine and quinoline there is no action, but most of the oxygenated alkaloids are attacked, yielding a new series of organo-metallic compounds, which will be the subject of further researches.

Products of Decomposition of α -Fluor-borated Acetone by Water.—F. Landolf.—The author has isolated acetone mono-fluor-hydrate and the corresponding di-fluor-hydrate.

Neutralisation of Glycolic Acid by Bases.—M. de Forcrand.—Glycolic acid forms two kinds of combinations; the one kind being true salts and the other alcoholates. The author has measured the neutralisation-heat of the acid with lead, magnesium, copper, and zinc.

A New Base of the Quinoleic Series, Phenol-quinoline.—E. Grimaux.—The base in question, $C_{15}H_{11}N$, is formed on heating to from 170° to 180° a mixture of aniline, nitro-benzol, sulphuric acid, and oil of cinnamon. It forms fine white needles, fusible at 84° ; very soluble in ether, sparingly soluble in cold alcohol, but more dissolving in 3 to 4 parts at a boiling heat. The hydrochlorate, the sulphate, and the chloro-platinate are crystalline, but the two former are partially decomposed by a large excess of water.

Derivatives of Strychnine.—M. Hanriot.—The author has obtained a dinitro-strychnine by acting upon the base with an excess of strong nitric acid, keeping the mixture at -10° . On treating the hydrochlorate of dinitro-strychnine with sodium amalgam, he obtains diamido-strychnine, the properties and reactions of which are described.

Sulphocyanacetone.—J. Tcherniac and R. Hellon.—The authors have obtained this compound by means of barium sulphocyanide, which is the best agent for transforming the organic chlorides in organic solution into the corresponding sulphocyanides. Sulphocyanacetone is a colourless oil, which turns a deep red on long exposure to the air. Its specific gravity at 0° is 1.209. It cannot be distilled without decomposition, even in a vacuum, and it is scarcely volatilised in a current of steam. It is slightly soluble in alcohol and ether.

Chloronitric Camphor.—P. Cazeneuve.—This compound is obtained in white crystalline needles on allowing hot fuming nitric acid to act upon normal camphor monochloride.

No. 10, March 5, 1883.

Theory of Electro-magnetic Machines.—M. Joubert.—The determinations effected by M. Tresca with the machines of M. Deprez give for the first time in a precise manner the measurement of the phenomenon already known but not explained, that there is a loss of work in the machine over and above that which follows from Joule's law. This loss has been ascribed to various causes, but the following, which to the author appears the most important, has not been pointed out. All the so-called continuous current machines are composed of a

certain number of elements, such as the strands of a Gramme's ring, which in the case where the machine acts as a recipient pass from a position where the potential energy has the maximum value W_0 , to another exactly opposite of the minimum value W_1 . The difference $W_0 - W_1$ represents the electro-magnetic work performed by the strand in passing from the first position to the second. In order that the movement may continue, it is necessary at this moment to reverse the direction of the current in the strand, *i.e.*, to destroy, in the form of a pure loss, the electric energy which it possesses, and restore to it the primitive energy, W_0 . The operation is repeated twice for each revolution per strand.

Dissociation of the Hydrobromate of Hydrogen Phosphide.—F. Isambert.—Like the bihydrosulphate the hydrobromate is dissociated, and gives rise to hydrobromic acid until the pressure of the two gases attains a certain limit, constant at a given temperature, which increases slowly at first, and then more rapidly.

Sulphuric Hydrochlorate.—J. Ogier.—The author has studied the thermic relations of the compound S_2O_6HCl of Prof. Williamson. He finds its vapour-density somewhat lower than is given by the latter.

Pyrosulphuryl Chloride.—J. Ogier.—In opposition to M. Konowaloff, the author finds the vapour-density of this compound 3.72, and not 7.4.

Formation-Heats of Solid Glycolates.—M. de Forcrand.—The author's results for the salts of potassium, sodium, ammonium, barium, strontium, calcium, magnesium, zinc, copper, and lead, as compared with the corresponding acetates and oxalates, are given in a table.

Hydrocarbides of Peats.—E. Durin.—The author distils at a low temperature in a vacuum with a current of superheated steam. He obtains from peat fatty acids, which may possibly contain a certain amount of paraffin.

Bulletin de la Société Chimique de Paris.

No. 3, February 5, 1883.

Study on the Combustion of Explosive Gaseous Mixtures.—MM. Mallard and Le Chatelier.—This memoir, which is continued from p. 2 of the present volume, has been already noticed.

Reciprocal Displacement of Acids combined with Mercury Oxide.—M. Berthelot.

Researches on the Absorption of Gases by Platinum.—M. Berthelot.—These two papers have been already noticed.

Physiological Action of Picoline.—MM. Œchsner de Coninck and Pinet.—The experiments of the authors prove that picoline presents energetic poisonous properties. Their conclusions are thus contrary to those of Dr. Mackendrick.

Essence of Angelica.—Laurent Naudin.—The author maintains that he succeeded, prior to MM. Beilstein and Wiegand, in demonstrating the presence of terebangeline in this essence. It is capable of polymerisation by boiling at 175° . By operating in a vacuum the author succeeded in isolating from the crude essence a single carbide, $C_{10}H_{16}$, an isomer of terebenthene.

A Case of Physical Isomerism of Monochlorated Camphor.—P. Cazeneuve.—Already noticed.

Certain Azo-Derivatives.—C. Girard and A. Pabst.—The authors, in their researches on the diazo compounds, have obtained a number of new combinations, which may be of interest as regards their tinctorial properties. The diazo-derivative of sulphanilic acid gives, with dimethyl-aniline, resorcin, and α -naphthol, yellows; with β -naphthol and diphenylamine, oranges. Methyl-resorcin produces likewise a yellow-orange. By combining diazo-phenyl sulphurous acid with pyrogallol sulphurous acid, they obtain a deep orange which is transparent, somewhat fugitive, and does not cover the fibre. Cresylol gives

also an orange. With methyl-diphenylamine they obtained a fine deep orange differing little from that derived from diphenylamine. Methyl-dixylidine gives an orange-scarlet, and methyl-dinaphthylamine an orange-red. Naphthylamine sulphurous acid yields a diazo-derivative, which, with methyl-diphenylamine, produces a ponceau red. We obtain analogous shades with benzyl-diphenylamine, dixylidine, methyl-dixylidine, dinaphthylamine, cresyl naphthylamine, methyl dinaphthylamine, ethyl-dicresylamine, liquid or solid, and amyl-diphenylamine; these shades vary from a scarlet to a crimson. Diazo-dinitrophenol, obtained from picramic acid, gives, with resorcline, a garnet-red, which passes rapidly into a maroon, and is probably decomposed. The ammoniacal solution is garnet-red, and dyes fibres a reddish maroon. With methyl-resorcline there is obtained a very fine garnet-red, and with the sulpho acid of dimethyl-resorcline, a reddish brown. Phenol yields an impure brownish orange; methyl-naphthol, a violet; amido-azo-naphthaline, an intense brown; and gallic acid, a very fine yellowish brown. Cœruleine combines difficultly, yielding a dirty green. Sodium alizarine sulphite gives a brown-green, slightly dichroic; rosaniline sulphite, a garnet-brown, equally dichroic; and anthraquinone sulphite, a greenish brown, almost olive. Phthalic acid and phthalimide give an impure and transparent yellowish brown. The azo-compounds are so much the less tinctorial as their molecule is more symmetric. The introduction of a sulpho-conjugated group turns the colour to an orange-yellow, whilst the addition of methyl in the phenolic function removes the shade rather more towards a red.

Swedish Correspondence.—Atomic Weight of Yttrium—P. T. Clève.—The author finds this atomic weight = 89.02, or, in round numbers, 89. He remarks that since the discovery of terbium, the absence of absorption rays is no longer a proof of the purity of yttria.

Journal für Praktische Chemie.
New Series, Vol. xxvii., Part 1, 1883.

Studies on Chemical Dynamics.—Dr. W. Ostwald.—First Treatise: The Action of Acids upon Acetamide.—We have here merely the first portion of a voluminous and important work, which does not admit of abridgment. The author's result is that magnitudes of affinities are as the square roots of the speeds of the reactions which they occasion.

Phenylised Carbonic Ethers and their Conversion into Salicylic Acid.—W. Hentschel.—The author treats successively of the conversion of phenyl-carbonic ethyl-ether and of diphenyl-carbonate into salicylic acid.

Chemical Analysis of the "Kronenquelle" at Salzbrunne in Silesia.—Theodor Poleck.—The interest of this paper, if any, will be confined to those who study the medical action of mineral springs.

Cosmos Les Mondes.
No. 6, February 10, 1883.

A New Material for Electrodes.—In the surgical applications of electricity M. Apostoli recommends electrodes of potter's clay.

Nascent Hydrogen.—Dr. D. Tommasi.—M. Berthelot, in a late issue of the *Revue Scientifique*, has given an account of the properties of nascent hydrogen quite similar to that which the author put forward in 1878, *i.e.*, that the properties of nascent hydrogen are not inherent in an allotropic state of the gas, but depend on its being accompanied by the entire quantity of heat which was produced during its liberation.

The Theory of M. Maumené.—An extract from the author's reply to a letter addressed to him by M. Tommasi.

No. 7, February 17, 1883.

Determination of Phosphoric Acid in Arable Soils.—P. de Gasparin.—Already noticed.

No. 8, February 24, 1883.

Falsification of Cement.—The article used for this fraud is the slag of iron furnaces, finely ground.

Preservation of Meat.—M. Pavesi proposes to preserve meat by treatment with *aqua regia*, which he applies also to anatomical preparations. The proportions to be used are not stated.

Dynamogen (!, a New Explosive Paper.—M. Pétry boils together 150 grms. of pure water, 17 grms. of potassium ferrocyanide, and the same weight of powdered charcoal. When the whole is incorporated the heat is withdrawn, and there are added 35 grms. potassa, 70 grms. potassium chlorate, and 10 grms of starch previously ground up with 50 grms. of water. The whole is stirred till it forms a uniform paste, which is brushed upon common filter paper, applying in succession three coats upon each side.

No. 9, March 4, 1883.

Historical Note on the Magnetic Needle.—According to *l'Electricité*, Dr. Gilbert, in some of his researches on magnetism was anticipated by Fra Paolo Sarpi.

Rapid Formation of Veins of Ore.—According to Dr. Fleitmann, a ditch having been filled up with common ferruginous clay, it was found on digging it up two years afterwards that the clay was entirely white, whilst the iron was arranged in slender veins of pyrites.

Calories of Combination of the Soluble Compounds of Barium.—Dr. Tommasi.—The author has calculated the combination-heats according to his theory, and finds the results agree closely with the experimental values as determined with the calorimeter.

Annales de la Société des Sciences Industrielles de Lyon.
No. 3, 1882.

This issue contains no chemical memoirs or notes.

Revue Universelle des Mines, de la Metallurgie, &c.,
No. 3, November and December, 1882.

This number contains no chemical matter.

MEETINGS FOR THE WEEK.

TUESDAY, 27th.—Institution of Civil Engineers, 8.
Royal Medical and Chirurgical, 8.30.

THURSDAY, 30th.—Chemical, 8. (Anniversary).

ST. PAUL'S SCHOOL.—An Examination for filling up about Six Vacancies on the Foundation will be held on the 10th April, 1883.—For information apply to the Clerk to the Governors, Mercers' Hall, E.C., or to the School Secretary St. Paul's Churchyard, E.C.

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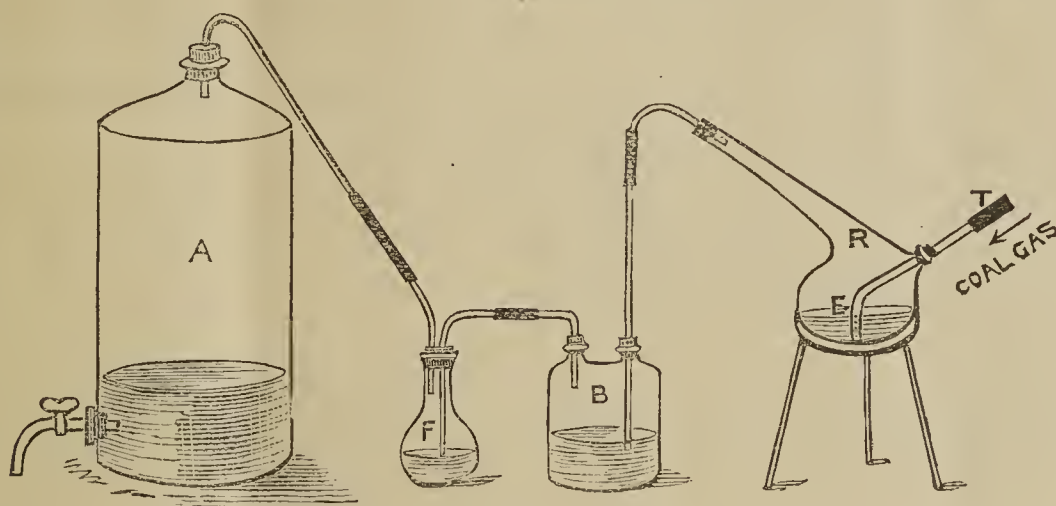
VOL. XLVII. NO. 1218.

PREPARATION OF HYDROGEN SULPHIDE FROM COAL-GAS.

By I. TAYLOR, B.A., Science Master at Christ College, Brecon.

HYDROGEN sulphide may be prepared very easily, and sufficiently pure for ordinary analytical purposes, by passing coal-gas through boiling sulphur. Coal-gas contains 40 to 50 per cent of hydrogen, nearly the whole of which may, by means of a suitable arrangement, be converted into sulphuretted hydrogen. The other constituents of coal-gas—methane, carbon monoxide, olefines, &c.,—are not affected by passage through boiling sulphur, and for ordinary laboratory work their removal is quite unnecessary, as they do not in any way interfere with the precipitation of metallic sulphides.

A convenient apparatus for the preparation of hydrogen sulphide from coal-gas—such as we have at present in use in the Christ College Laboratory,—consists of a retort, R, in which sulphur is placed. Through the tubulure of the retort there passes a bent glass-tube, TE, perforated near the closed end F with a number of small holes. (The perforations are easily made by piercing the partially softened glass with a white-hot steel needle—an ordinary crotchet needle, the hook having been removed and the end sharpened, answers the purpose very well). The end



of the glass tube is connected by caoutchouc tubing with the coal-gas supply—the perforated end dipping into the sulphur. The neck of the retort—inclined slightly upwards to allow the condensed sulphur, as it re-melts, to flow back,—is connected with a wash-bottle, B, to which is attached the flask, F, containing the solution through which it is required to pass the hydrogen sulphide; F is connected with an aspirator, A.

About one pound of sulphur having been introduced into the retort and heated to the boiling-point, the tap of the aspirator is turned on and a current of coal-gas drawn through the boiling sulphur; the hydrogen sulphide formed is washed by the water contained in B, passes on into F, and finally into the aspirator. The speed of the current may be regulated by the tap, and as the aspirator itself acts as a receptacle for excess of gas, very little as a rule escapes into the room, and consequently unpleasant smells are avoided.

This method of preparing sulphuretted hydrogen will, I think, be found useful in the laboratory. It is cleanly, much cheaper than the ordinary method, and very con-

venient. During laboratory work, a burner is placed under the retort and the sulphur kept hot, so that its temperature may be quickly raised to the boiling-point when the gas is required. From time to time it is necessary to replenish the retort with sulphur and to remove the condensed portions from the neck.

ON THE HYDRATE OF CHLORINE.*

By Professor E. MAUMENÉ.

THE note of M. Ditte compels me to publish the experiments which I made a long time ago upon this substance, the composition of which is not singular. The hydrate formed at about 5° by the rapid passage of a current of chlorine is generally of a pale colour, differing little from that of the solution. If the crystalline matter, after being drained in a funnel, is slightly compressed between folds of filter-paper, and is submitted to analysis, we always find a little more than 12 equivalents of water to 1 of chlorine. Faraday obtained 10 equivalents: I shall immediately say wherefore. If we enclose the hydrate—the formula of which I have just given—after being drained and pressed between paper in a bent tube, according to the directions of Faraday for obtaining liquid chlorine, we may easily see in the part of the tube bordering upon this liquid the appearance of crystals much more deeply coloured than those of the solution, and much less laminated than the foregoing. These crystals are produced and persist as long as the solution of chlorine in the main limb of the tube is hot enough not to admit of an absorption of chlorine. Their composition varies. If they are formed in presence of a sensible excess of

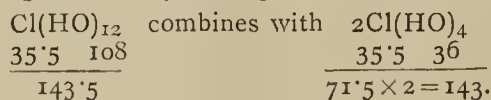
liquefied chlorine they present the composition $\text{Cl}(\text{HO})_4$. But if they are close to the solution, and especially if they are dissolved in the tube by causing a little of the solution in the large limb of the tube to pass into the smaller limb, taking care to keep the large limb the hotter of the two, they may be reproduced by a slight and gradual refrigeration of the smaller limb, with a variable composition, but bordering upon $\text{Cl}(\text{HO})_7$.

These three results were predicted by my theory.

Chlorine, when in presence of a weight of water differing little from its own, can combine with an equal weight, or 36. These conditions are realised in the small limb of the apparatus; when the crystals are formed in the vicinity of the liquefied chlorine we obtain $\text{Cl}(\text{HO})_4$. These crystals appear to me cubic, and such as M. Ditte has just described them. When, on the contrary, the water is in excess, the $\text{Cl}(\text{HO})_4$ combines with a weight of $72=8\text{HO}$, and forms crystals octahedral, but still orthorhombic, the surfaces of which present very unequal

* Communicated by the Author.

developments. These crystals, of a colour almost identical with that of their solution, contain 12HO , and it is even common to obtain $12\cdot1$ and $12\cdot2$, because it is very difficult to dry these bodies, even with a patience which the cold renders rather painful. Lastly, as the theory indicates, the two hydrates $(\text{HO})_4$ and $(\text{HO})_{12}$ may combine together in equal weights, and the result is—



The compound thus formed is $\text{Cl}_3(\text{HO})_{20}$ or $\text{Cl}(\text{HO})_{6\cdot67}$. It will be understood that the analysis gives figures bordering upon $(\text{HO})_7$. Chemists who have paid some attention to my theory will comprehend without trouble how Faraday has obtained a mixture $\text{Cl}(\text{HO})_{10}$. I think it needless to dwell on this point. As M. Ditte has given no numbers I hope that the present note may aid him in completing his study, and I await with absolute confidence the confirmation of the results which have just been given. The theory has hitherto not received the slightest contradiction from an age of exact experiment.

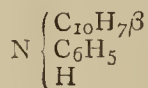
ON SOME COLOURING MATTERS BELONGING TO THE ROSANILINE SERIES.

By RAPHAEL MELDOLA.

(Continued from p. 133).

(ADDITIONAL NOTE).

A NAPHTHYLATED derivative of rosaniline analogous to diphenylamine blue is produced by heating β -naphthyl-phenylamine—



with oxalic acid or any of the oxidising substances which transform diphenylamine into its blue. After purification the colour can be made into a sulphonic acid, which dyes of a greenish shade of blue far beyond diphenylamine blue in green nuance, but not quite so brilliant as the latter on silk or wool. α -naphthyl-phenylamine does not readily yield a blue by the action of oxalic acid, nor is any colour obtained by this means from di- α -naphthylamine or di- β -naphthylamine.

None of the colouring matters described in these notes have as yet been submitted to detailed scientific examination, but as they may be of technical use I have thought it advisable to make known their existence in anticipation of further work upon the aromatic derivatives of methane.

ON THE DETERMINATION OF NITROGEN IN ORGANIC BODIES.

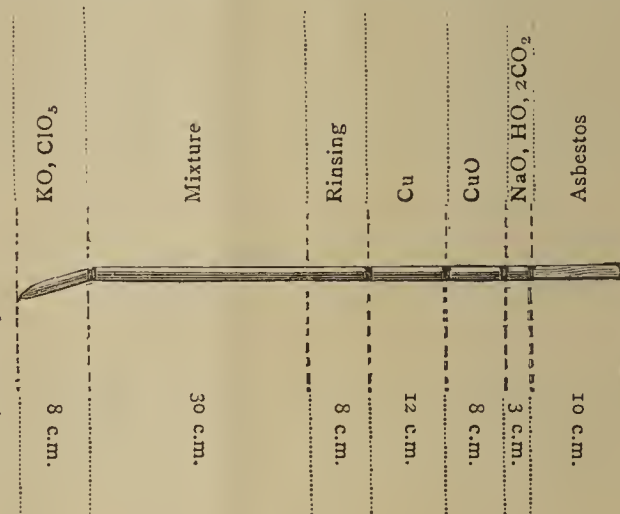
By S. W. JOHNSON and E. H. JENKINS.

For the volumetric determination of nitrogen the authors use a modification of the process of Dumas, by which they have obtained good results. Whilst generally the nitrogen is driven by carbonic acid into the measuring cylinder, they collect the gas in a Schiff's apparatus by means of a Sprengel's mercurial pump. The combustion tube is about 70 c.m. in length, but bent downwards at its farther end, as shown in the figure.

This end is charged with potassium chlorate, then follows the mixture of the substance with copper oxide and the copper oxide used for rinsing the interior of the tube: then a stratum of metallic copper; then granular copper oxide and a little sodium bicarbonate. The front of the tube is filled with asbestos, and the strata, as

shown in the figure, are separated by asbestos stoppers. Before beginning the combustion the tube is thoroughly evacuated with the mercurial pump, observing if the connections are air-tight. The small layer of sodium bicarbonate is then first heated so as to fill the combustion tube and the descending tube of the pump with carbonic acid. The gas-tube of the pump is then conveyed into the collecting apparatus, so that it opens under the mercury junction. The combustion is then carried on in the ordinary manner, the potassium chlorate being heated last when the escape of gas has almost ceased. The oxygen thus liberated completes the combustion of the organic matter, and re-oxidises the reduced copper. The rather long stratum of metallic copper prevents the entrance of oxygen into the collecting apparatus. As soon as the oxygen distinctly oxidises the stratum of copper its evolution is stopped, and the pump is set in motion. The gas is thus completely passed into the measuring tube, and the mercury escapes from the lateral aperture of the collecting apparatus.

Max Gruber proposes also a modification of the method of Dumas. He takes a combustion-tube of 95 to 100 c.m. in length, draws it out to a point at the hinder end, and fills it as follows:—An asbestos stopper, 25 to 30 c.m. sodium bicarbonate, an asbestos stopper, 8 c.m. of granular copper oxide, an asbestos stopper, the mixture of the substance with finely granular copper oxide (about 12 c.m.),



a rinsing with powdered copper oxide, 8 c.m., an asbestos stopper, a stopper of copper-wire gauze, 8 c.m. of granular metallic copper, a stopper of copper-wire gauze, 8 c.m. copper oxide, and lastly an asbestos stopper.

At the outset Gruber passes through the tube carbonic acid from a Kipp's apparatus to expel the air; fuses up the drawn-out end of the tube, and evolves carbonic acid by heating a part of the sodium bicarbonate. The combustion is conducted as usual, and finally all the gas is driven into the measuring cylinder by heating the rest of the sodium bicarbonate. After the absorption of the carbonic acid the measuring-cylinder is placed in water which has been boiled, and the volume is read off.

Gruber compares the results of this process with those of Varrentrapp and Will's method. He shows that besides the nitro-compounds there are others whose nitrogen cannot be determined by heating with soda-lime, and he admits that such bodies may possibly be found among the albumenoids. For the substances which he examined—meat and peas—he finds the Varrentrapp-Will method perfectly available.

Gruber does not find the precautions suggested by Makris—ignition at a low temperature and the addition of sugar—at all needful.

Gassend and Quantin give results on the soda-lime process which are in complete opposition to those of Gruber. They maintain the results of the analysis depend very closely on the quantity of the substance taken, the length

of the tube, and the duration of the process. They recommend to take so little of the substance that the ammonia may not neutralise more than half of the acid: they select a tube not longer than 40 c.m., and they conduct the process so quickly as not to last more than thirty minutes.

Instead of determining the residual acid by titration, or of precipitating the ammonia as platinum chloride, Mohr evaporates the acid (hydrochloric) to dryness, and determines the chlorine with silver solution in the usual manner.

For determining the nitrogen in hair, wool, &c., Krauch treats with sulphuric acid, neutralises excess of acid with calcium carbonate, and thus obtains a mass which can be readily pulverised.—*Zeitschrift für Analytische Chemie*, xxi., p. 274.

ON THE PRESSURE OF SATURATED VAPOUR OF MERCURY.

By H. HERTZ.

THE following determinations of the pressure exerted by saturated mercurial vapour were made in the course of the author's experiments on evaporation. In computing the latter he made use at first of the figures given by Regnault, but they were evidently unsuitable. If the results obtained according to the second method were tabulated in such a manner that for a given temperature of the surface the quantities evaporating in a unit of time were represented as abscissæ and the accompanying pressures as ordinates, series of points were obtained which approximated very closely to straight lines. If these lines were produced even very little beyond the observed interval those pressures were found which corresponded to the evaporation null, and must consequently represent the pressure of saturation. The numbers thus found were all smaller than those of Regnault. That the explanation of this circumstance must be sought for in errors of the latter seemed probable in consequence of the experiments of Herr Hagen, but the values which he found deviated also from the right lines obtained. Hagen himself conjectured that his values were too small for temperatures above 100°, which came more especially in question.

The author describes these experiments with reference to two diagrams, and proceeds:—

As for the calculation of these experiments, I have attempted to apply to them a formula not yet used for this purpose. It is theoretically justifiable, and must be correct with the same degree of approximation with which the saturated vapour follows the law of Gay-Lussac and Mariotte for highly rarefied vapour. Supposing the validity of this law, the vapour has a constant specific heat at a constant volume. Let it be c , let s be the specific heat of the liquid, and ρ_T the internal evaporation-heat for the absolute temperature T . Then, on the supposition made, $\rho_T = \text{constant} - (s - c)T$. This proposition is proved by conceiving a quantity of liquid of the temperature T , brought to any other temperature, converted into vapour without external work, and such vapour, still without external work, brought back to the temperature T and precipitated. In this process the liquid can neither have received nor given off heat. On the other hand, according to the mechanical theory of heat, we have—

$$\rho_T = A u (T \, d\phi / dT - \phi),$$

where ϕ denotes the pressure of the saturated vapour, and u its specific volume; consequently $u = RT/\phi$. If we eliminate ρ_T and u from the three above given equations we have a differential equation for the curve of vapour-tension, which gives the following integral:—

$$P = k_1 T^{1 - \frac{s-c}{AR_c} - \frac{k_2}{T}}.$$

For mercury s is known. Winkelmann, from his own experiments and from a statement of Regnault's, finds a slight decrease for this magnitude at increasing temperatures, and as a mean value between 0° and 100° $s = 0.0330$. Experiments performed by Dr. Ronkar in the Physical Institute here show that the change between -20° and +200° is exceedingly small, and give the mean value $s = 0.0332$. This value is introduced into the calculation. The quantity c is found by the consideration that according to the results of Kundt and Warburg the relation of the specific heats for mercury vapour = 5/3, and it is found = 0.0149. Hence the exponent of T appears as -0.847. The two remaining constants are determined by observation. The constants thus determined are subjected to a correction, in which it is rational to assume the observations of pressure as correct, and therefore to reduce the sum of the squares of the errors of temperature to a minimum. In this manner the author finds $\log k_1 = 10.59271$ and $\log k_2 = 3.88623$. If these constants are introduced into the formula, and if it receives a form more convenient for calculation, it becomes

$$\log \phi = 10.59271 - 0.847 \log T - 3342/T.$$

The author gives a table of the pressure of the vapour for every 10 degrees from 0° to 220°. At 0° it is 0.00019, at 100°, 0.285; at 200°, 18.25; and at 220°, 3490.

It must be remembered that ϕ becomes = 0 at $t = -273^\circ$, and that the formula for the internal latent heat of the vapour gives the value $\rho_T = 76.15 - 0.0183T$. The numbers given above deviate not inconsiderably from those both of Regnault and of Hagen. They are, throughout, smaller than those of Regnault, but approach nearer as the temperature rises, and coincide with them near 220°. They are greater than Hagen's numbers above 80° (100°?), coincide almost with them between 80° and 100°, and are smaller below 80°.

The chief interest attaches to the pressure of the vapour at the ordinary temperature of the air. According to the results of these investigations it is less than the thousandth part of a millimetre. A correction for this pressure cannot therefore be introduced in reading the indications of the barometer and manometer. The smallness of the pressure in question, rather than any particular property of mercury, is probably the cause of the vanishing influence which the mercurial vapour always present exerts upon the discharge phenomena in Geissler's tubes.—*Wiedemann's Annalen*, 1882, p. 193.

PYROLOGICAL NOTES.

By Lieut.-Colonel W. A. ROSS, F.G.S., late R.A.

(Continued from p. 79.)

XI. BORIC ACID AND ALUMINIUM PLATE (Continued).

Is the Silica Compound a Compound of Hydrogen?

FOR the use of those readers who may not have followed my "Notes" IX. and X. in the *CHEMICAL NEWS*, vol. xlvii., pp. 28, 78, I will now collect the facts mentioned in those articles, as follow:—

A. Pure chemically-prepared silica, or powdered rock-crystal, is utterly unattacked and unchanged in boric acid before the blowpipe: the bead remaining clear.

B. *Calcium Pyroborate* (formed as described in note IX.) is also unattacked and unchanged under similar conditions: the bead remaining clear.

C. But when the former is dissolved in the latter (as A, B), or the latter added to the former (as A+B), and treated in boric acid before the blowpipe, a remarkable change takes place; in both cases attended with the emission of a large quantity of *opaline matter*—proved to emanate from the silica (A)—into the clear bead, rendering it and successive beads opaque.

D. In the case of A, B, notwithstanding A's loss of

opaline matter, the compound A B is much heavier than it was before this loss, in consequence, evidently, of an absorption of boric acid from the containing bead; and it was proved (in note IX.) that A alone effected this absorption through B, *exchanging*, in fact, the substance causing opalescence in the containing boric acid bead, for a heavier equivalent of boric acid, supplied by the bead itself.

E. In the case of A+B, no exchange takes place, but the opalescence-causing substance is simply extracted from A through some force or influence exerted on it by B; which latter remains unchanged in weight, and seems merely to transfer the substance extracted from A to the containing boric acid bead. A's loss, therefore, in this case, is direct and uncompensated, and seems, by several experiments made in 1880, to be very considerable, viz., about three-fifths, or 60 per cent.

I trust I have now made this matter pretty clear to those who have honoured me by their attention, without much confusion, which it is difficult to prevent in the absence of illustrative experiments, because I wish to submit to them my reasons for attributing this opalescence-causing substance (to be called afterwards for brevity, H) to some compound of hydrogen, for which purpose it will be necessary to cite here, some more facts.

F. *Freshly calcined lime*, applied to boric acid before the blowpipe, affords an interior mass or ball, *four times* the weight of the lime (1). *Hydrated lime*, gently dried, and similarly treated, affords a ball *three times* the weight of the calcium hydrate (2). *Pure marble*, or *calcite*, similarly treated, affords a ball *twice* the weight of the calcium carbonate (3).

F(1) causes no opalescence to the containing bead of boric acid; F(2) and F(3), on the contrary, render the bead, in each case, opaque with opaline matter, and, as I have before mentioned in these notes, the calculation based upon the difference of weight between F(1) and F(2), gives to—

Calcium hydrate a percentage of CaO, 75.0; H₂O, 25.0.

By calculation of chemical equivalents calcium hydrate has a percentage of CaO, 75.7; H₂O, 24.3.

(It is a notable fact that in calcium pyroborate the percentage is CaO, 25.0; B₂O₃, 75.0 so that what is termed water has here nearly the equivalence of lime, and lime that of boron trioxide.)

There can be no possible doubt here, then, that the opalescence in the case of calcium hydrate, treated in boric acid before the blowpipe, is *entirely due to the combined or chemical water* present in the hydrated lime, which is "exchanged for a heavier equivalent of boric acid, supplied by the bead," precisely as the substance evolved from silica, and causing opalescence in boric acid before the blowpipe, is exchanged in fact (D.)

If I can now show that freshly-calcined lime (affording no opalescence in boric acid before the blowpipe) can be hydrated so as afterwards to afford opalescence when treated in boric acid before the blowpipe, *by means of the opalescent matter derived from pure silica or rock crystal*, I think you and the chemist readers of the CHEMICAL NEWS will admit that I have proved my case. This can apparently be done as follows:—1. A red-hot boric acid bead, which has been rendered quite opaque by means of the pyrological treatment of A, B, or of A+B (it is quite immaterial which), is taken upon a *larger* fragment of pure lime, which has been strongly calcined in O.P. held in a platinum wire rolled round it, and the lime and opaque boric acid bead together are then exposed to the heat of a blowpipe pyrocone (O.P.) from a heated gas apparatus, the blast being propelled by a powerful foot blower. The immediate effect of this is that the lime fragment at first emits intense white light, and gradually *clarifies the opaque bead*, which sticks to it, and it then does not glow quite so strongly, when this part of the operation must be stopped. 2. The fragment of lime is now crushed to coarse powder, care being taken not to mix with its powder any part of the boric acid bead, and

a little is immediately applied to a fresh, clear bead of boric acid O.P., when *opalescence is at once communicated to the bead by the freshly-calcined lime*, showing that it has now been hydrated.

Assuming, then, as a proved fact that this peculiar grey opalescence communicated to clear beads of boric acid before the blowpipe denotes the presence of combined water, we at once obtain in the former phenomenon a very useful and important test for the presence of the latter, even approximating to quantitative results. For instance, if we dip a red-hot bead of pure boric acid into distilled water, the bead becomes crystalline and opaque, but only on the surface: when it is held for a minute or so, in O.P. the bead fuses, emits bubbles evidently of steam, and becomes perfectly clear and transparent again, so that water of crystallisation passes off from it by heat, without decomposition. But if we now acidulate the water with nitric, hydrochloric, or sulphuric acid, dip the red-hot bead in the mixture, and fuse it again in O.P., it immediately exhibits permanent grey opaline matter on cooling (combined, or "chemical" water). I find that the powder of minerals containing over 10 per cent of this combined water renders the whole of an ordinary-sized bead of boric acid quite opaque before the blowpipe.

Alkaline Reagents on Aluminium Plate before the Blowpipe.

When we fuse soda or potash (Na or K carbonate) on platinum-foil before the blowpipe, as in the case of testing for manganese, the melted reagent spreads out as a thin pool over the surface of the metal, and sticks to the latter so tenaciously on cooling that from the first result it is difficult to get proper reactions out of such a thin crust of reagent, and from the second, almost impossible to clean your platinum except by boiling it in water. If we similarly fuse these reagents on a stick of charcoal as a support, they sink when melted into the pores of the coal, and are lost to sight altogether.

Now these reagents immediately assume the *spherical shape* when fused before the blowpipe on bare aluminium plate, in consequence of its heat-conducting capacity before described, because this capacity *isolates* the heat upon the assay, *every particle* of which is consequently rendered fluid, and so enables the whole mass to assume sphericity, in obedience to the laws of gravitation and cohesion. The fluid red-hot bead rotates rapidly in O.P., precisely as a bead of borax does on platinum wire; being thus as susceptible of oxidation, and, of course, far more of reduction in H.P. as the latter. When cool, the round ball does not stick to the plate at all, but may be taken off by ordinary pliers. The advantages of this fact are too numerous to mention here: they will doubtless present themselves at once to your pyrological readers, but I may just conclude this paper by one illustration.

The presence of iron in a sulphide may be detected very rapidly by fusing the powder (after roasting it in O.P.) with potash on bare Al plate in a long P.P., when the smallest proportion exhibits a *pink coloured* ball or bead; any sulphur present only forming a reddish brown hepatic bead after heating in H.P. Plattner, I think, mentions that iron oxide is very soluble in soda B.B., but from this very cause it disappears with its alkaline reagent into the charcoal and "makes no sign"!

Combination of Free Hydrogen with Ethylene.—

M. Berthelot.—The author formerly succeeded in combining free hydrogen at a dark red heat with the hydrogen carbides, and especially with ethylene, but the reaction was limited by the decomposition of the hydrides in virtue of a true dissociation. In these experiments, conducted at about 550°, only 51 per cent of the ethylene was transformed. On operating at a lower temperature he has since succeeded in extending the conversion to 70 per cent, and in preventing the formation of secondary compounds.—*Bull. de la Soc. Chim. de Paris.*

EXPLOSIVE AND DANGEROUS DUSTS.*

By PROF. T. W. TOBIN, C.E., Ph.D.,
Of the Polytechnic Society, Kentucky.

DURING the month of May last I was honoured with an invitation to address the Kentucky Miller's Association on "Flour Explosions." Being a subject in which I had for many years been interested, I cheerfully undertook the preparation of a lecture, with illustrations. The experiments, although not new, for chemists well know the combustible nature of organic dust in a finely divided condition, yet so impressed my audience that I was more than repaid, on my part, in their interest and applause for the small amount of labour expended. In preparing that lecture there appeared to me certain conditions governing the combustible state of flour which hitherto had been passed by in investigating the appalling catastrophes that from time to time befall our national industries, in the form of mill fires and explosions. Many of my suggestions, the outgrowth of subsequent experiments, have been received with favour; and my theories, if such I may presume to term them, have had the endorsement of practical men before whom they have found their way. The desire to prosecute the truth, which is implanted in every scientific mind, has led me further, and I am here to report progress and court your criticism.

Dust Under the Microscope.—Let us together, then, retrace the narrative of these researches. I will first call into requisition that wonderful instrument that science plunges into the mysterious and opens out its inner secrets to the light of day—the microscope. As it would be difficult to show you individually the objects that I employ as illustrations, I made careful drawings and photographs of them, and by means of a powerful oxyhydrogen light will project magnified images of these upon the disk now before you. (*The lecture room was here darkened and the subsequent microscopic illustrations shown on a screen, magnified to many million times the size of their originals.*)

1. I take first some ordinary flour, commonly known as "Graham meal," and we find that it consists of quite a miscellaneous gathering of various bodies. There are present: (1) the skins of the wheat-berry; (2) the hairs or "beard;" (3) cells of gluten, a wax-like substance, being the most nutritious portion of the grain; and lastly, (4) the starch in various sized granules. This body forms the bulk of ordinary flour and flour-dust. Now, in order to understand intelligently the natural placement of these parts of the wheat grain, I will bring magnified images of that body.

2. This shows: (1) the beard; (2) the skins, three in number, that enclose the internal starch or gluten; (3) at the bottom there will be noticed the germ, and contiguous with it the crease. Now, the first operation of the miller who has recourse to the newer processes of reduction, is to clean by brushing or agitation, the whole surface of the grain for subsequent operations, and secondly, to break open this crease and get rid of the germ and incidental impurities that are usually there. In so doing a small amount of flour is made, but being charged with impurities, is blown into the dust-room. There are then two classes of dust: 1st, wheat dust, obtained from cleaning the surface of the grain, and 2nd, the refuse flour dust discarded, because being mixed with germ and other foreign matter. Although in my investigations I found two separate channels and outlets, the character and condition of both classes of dust therein were almost identical in physical properties.

3. This will show by a section of the grain the disposition of the parts already described.

4. Pure starch granules, as found in "arrowroot." This may be taken as the typical element in flour dust. We mark the compact spheroidal form of the granule. At a temperature of 140° F. in water it swells, bursts, and is

converted into the well-known pasty mass used in the arts. In common with most organic matter, starch is combustible, and contains normally about 18 per cent of water.*

This amount varies, and exposed to a dry atmosphere, may be considerably reduced. I take it as a rational deduction that the most rapid combustion of flour, attended with explosive violence, would occur when freed from moisture. The individual granules burst simultaneously, and the disturbance thus produced bringing new supplies of oxygen, would instantly determine the rapid consumption by fire of the entire mass. This fact will be discussed further on.

5. Immediately following the starch granules we have a quantity of dust obtained from the club moss, called "lycopodium." It is the seed or spore of that plant. Notice the near resemblance in size and structure to the starch granule; but it differs in one respect in being of an oily nature, which (as our experiments will presently convince us), renders it very inflammable.

6. This is highly bolted flour, and as the microscope shows, freed from the husk, the beard, and even the gluten of the wheat, leaving nearly pure starch. We observe that there are three distinct qualities of the granule: (1) the giant; (2) the medium; and (3) the farina, or starch powder.

7. This view will give a fair idea of what change takes place in starch on submitting it to a heat of over 140°; in other words, it is cooked flour. The granules have all disappeared, and in their place are irregular masses of amorphous "dough" or "paste."

8. Some dust collected from the "wheat dust room" shows starch, husk, fractured gluten cells, the beard, and other impurities; it also contains, generally, "fungi," or "smut." The dry and oily nature of this dust renders it more inflammable than starch.

9. Wood abrasions from an axe-handle factory, showing the fibrous and cellular texture of the minute particles of dust. This material is inflammable owing to its extreme dryness.

Combustion.—I will now as briefly as possible lay down the principles that are generally acknowledged by chemists as underlying the phenomena of combustion in organic bodies and apply them to the special instances under consideration. The substances which we will now deal with consist of three elements: oxygen, hydrogen, and carbon. Although in variable quantities the oxygen and hydrogen are always in the ratio of water, *i.e.*, eight parts by weight of the former to every one part of the latter, heat is capable of determining their union and water is the result. Carbon or charcoal is thus left, and being incapable of existing in any but a solid condition, soon stifles further combustion. If, however, oxygen be added, either from the air or as a gas, perfect consumption of the body takes place. We know that a piece of wood, if an insufficient supply of air is present, can only become charred by the most intense heat known. This is the first principle that I will now endeavour to illustrate.

Experimental Demonstration.—Here is some hydrogen in a tube; it is very much the same as that burning from the lamps in the room. I plunge a lighted taper into it, and the taper is incapable of burning for lack of oxygen or air. Hydrogen, although a highly combustible body, will prevent combustion, and even suffocate this burning taper. I now add some air, neither in itself explosive nor combustible, and then heating the mixture, I get a deafening report. Beyond all question I have generated an explosive body.

Then I will take some flour, and perhaps I should tell you that, like the hydrogen when free from free oxygen or air, it is incombustible. Flour thrown on the glowing furnace will retard and even, if sufficient in quantity, extinguish the fierce fire. Like hydrogen alone, it is a non-supporter of combustion. Observe, I plunge a burning taper in this

* An Address read before "The Fire Underwriters' Association of the North-west," at Chicago.

* Miller's "Elements of Chemistry."

measure of flour, and, as you would predict, the taper goes out. Here is a substance, chlorate of potash, which is very rich in oxygen, and I cannot alone make it burn, as you may see. Two harmless bodies I mix; the essentials of combustion are supplied and brilliant fire is the result. Oxygen gas, always present in the air, an exceedingly active and corrosive body, is then the one thing needed to render these inert bodies combustible, and even explosive.

Moisture.—Water, in all its forms, is opposed to combustion, and its presence modifies the rapidity with which the consumption takes place. It is, I think, hardly necessary to illustrate this as a general principle, although in the sequel we shall find in it an element of great importance.

Now, it is by these simple principles that combustion in its varied phases, from the slow decomposition and decay of the green vegetable to the explosion of the modern flour mill, is governed. By the modification of them I think I can show you some interesting results.

Wood Dust.—Here is some dust from an axe-factory. It was obtained and has been preserved in a dry state. By means of a simple piece of apparatus I cause it to be blown about and thoroughly mixed with air. A flame is near it, rapid combustion takes place, and a column of fire of intense heat leaps up in the air, six or seven feet high.

Flour Dust.—This sack contains ordinary flour. Previous to the lecture some of it was placed in a drying oven and submitted to gentle heat. By this time much of the moisture usually contained in flour has been expelled; one condition has been fulfilled to make the substance combustible. I next comply with the other and mix it with air. See the result! Mark the violence attending the combustion.

You may seem astonished, and ask whether this is flour alone. Yes; from the same sack I use some more: this time not with the same result, for it is damp, and the air cannot mix sufficiently to render it even inflammable.

Then we arrive at a very important conclusion. The violence of combustion is the inverse of the moisture of the dust experimented upon.

Other Dust.—We will now put the testimony received so far to the torture of further investigation. I have some lycopodium. You remember its near resemblance to flour dust under the microscope. It is not necessary to dry this as we did the flour, for it is protected by an oily waterproof coat and moisture cannot enter it, but it requires air, for I plunge a lighted taper into its midst, and, as in other instances, neither will the powder burn nor will the taper. I urge some of it through the heated flame with this unexpected result: an all-devouring and explosive column of fire.

Explosion.—The results obtained so far convince us that dust is inflammable in degree according to its dryness. No actual explosion has yet been obtained in our experiments. Perhaps it will be well to define the term explosion, since there has been objection raised to its use in connection with flour combustion by some writers whose opinion is worthy of respect. It almost seems ridiculous to imagine anyone looking at the disaster at Minneapolis could so pervert the English language as to say that no "flour explosion" took place. Our dictionaries give us the definition of the word "to drive or burst out with a loud report or violence." Hitherto we have not then complied with this definition, and therefore had no explosion. Let us see if it is possible to obtain explosion, and by what means. When dry organic dust is heated to the point of ignition, the oxygen and hydrogen first combine to form water. Intense heat is thereby generated, and this heat acts in two ways: first, to char and finally convert the carbon into carbon dioxide gas; and, secondly, to expand the surrounding air. The gas and the heated air occupy considerably more space than in their first state, and the more rapidly these results are achieved the more nearly will the act approach the violence of explosion.

The air then plays as important a part as the dust, and should the air space be confined, but insufficient to restrain its force of expansion, explosion in the full sense of the term takes place.

Explosion, Intensity of Combustion.—We can trace the various degrees of combustion in the many mill and factory fires that have been placed on record. Notably amongst them I will call your attention to two—the terrible disaster of Minneapolis, which occurred May 2, 1878, and the Hecker mill fire in New York, July 31, 1882. In the former we may reasonably infer that the air was dry and the dust pretty generally diffused throughout its entire extent, owing to the long-continued and busy period the mill had been taxed with work. The wheat of that year, we are told, was hard and dry, and at the time of the explosion, 7.20 P.M., the air was chilly and the windows and openings generally closed. Here are conditions for explosion. In the latter I will take the testimony of the superintendent, Mr. J. V. Hecker, as recently given before the fire marshal of New York. He says: "The fire originated in the 'smutter' on the seventh floor. 'Smutter' are considered the most dangerous parts of the machinery of a mill, on account of the friction which may be produced by any foreign substance getting in and striking fire between the revolving cylinder and the case surrounding it. These cylinders were of stone and the cases of chilled iron. The smutters make from 250 to 300 revolutions per minute. The dust is sucked from under the smutters and forced by a fan into the (wheat) dust room through a spout about ten inches square. I think the fire was caused by a spark struck by friction in the smutters, igniting the dust and passing through the spout into the dust room and igniting the dust therein." That an explosion did not then occur, as in many other instances, was, I take it, owing to the fact that while the air in the mill was charged with fine dust the dryness was sufficient to cause the flames to spread with lightning-like rapidity through the entire building, making the 500 workmen run for their lives. There was insufficient moisture to allow the dust to burn with the violence characteristic of an explosion. From the meteorological record of that day I find the barometer stood at 30.42, temperature, 82° F., and there was 82 per cent moisture in the air, with cloudy sky. 30 per cent of humidity that day, in all probability, saved the nation from a disaster far more terrible than happened in Minneapolis, or since the history of milling has been recorded.

Many other illustrations might be taken which would find an intermediate place in the degrees of intensity of combustion. You will call to mind the candy-works explosion in the same city some years ago: that was an explosion of starch. The Ehret Brewery in August, 1881, experienced an explosion from the barley used in malting. Barley, in common with wheat and other cereals, consists principally of starch, and no difficulty is experienced in accounting for that phenomenon. The Pullman Car Works, at Detroit, 1880, had an explosion of dust in the spout used for conveying shavings from various portions of the factory to a place near the furnace. This spout is the counterpart of the dust room of the flour mill.

Conditions of Explosion.—We will now proceed with our experiments and see if we can cause those substances which hitherto have shown themselves as highly combustible to become explosive. We will confine the air space and see the result. For that purpose I have before you a simple piece of apparatus which, for a better name, we will call a dust or flour gun. It consists of a hollow shaft about seven feet high. At the top is a hopper, which by means of a paper cover I can close; at the bottom is a gas pipe to which is attached a Bunsen burner. By means of a trigger arranged near the top I can cause a fine shower of dust to descend and fill the shaft. When the first portion of it reaches the flame and the shaft is filled with dust, ignition takes place and the entire column burns. It is necessary that there should be a plentiful supply of air. This is provided for in numerous perfora-

Record of Temperature and Humidity of the Atmosphere at the Flour Mill of Messrs. Jones, Ballard, and Ballard, Louisville, Ky., August, 1882.

DATE.		EXTERNAL.		INTERNAL HUMIDITY.			WEATHER.
Day.	Hour.	Temperature.	Humidity.	Grinding Floor.	Bolting Floor.	Dust Shaft.	
Aug. 10	11 A.M.	70°	52 P.C.	67 P.C.	54 P.C.	.....	Clear
Aug. 11	12 M.	80°	51 "	62 "	65 "	.....	Fair
Aug. 12	3 P.M.	82°	45 "	60 "	53 "	.....	Fair
Aug. 14	3 "	89°	53 "	54 "	53 "	43 P.C.	Fair
Aug. 15	1 "	81°	87 "	83 "	83 "	60 "	Rain
Aug. 16	1 "	82°	83 "	87 "	87 "	63 "	Rain
Aug. 17	3 "	79°	57 "	64 "	64 "	53 "	Clear
Aug. 18	3 "	83°	48 "	52 "	52 "	38 "	Clear
Aug. 19	2 "	78°	50 "	55 "	58 "	41 "	Fair

tions about the walls of the machine. If the dust is now dry we have all the conditions for explosive combustion. Let us proceed :

I place some lycopodium and turn the trigger. The top is blown off and takes fire, so intense is the heat. Here is some wheat dust from the dust shaft of a flour mill. The result is much the same, only less in degree, and yet sufficiently illustrates the principles we have discussed.

The Wet Bulb Hygrometer.—Before proceeding further in our subject it is necessary that we should understand the construction and use of an instrument that will play an important part in the subsequent line of thought I purpose now leading you. It is known by the modest title of "Wet Bulb Hygrometer," and its mission is easily related.

Its indications tell us that the atmosphere about us on the clearest and brightest day or night contains a large amount of water dissolved in it : that this watery vapour or gas is very transient in its nature, but that very seldom is the air fully charged, and never is moisture entirely absent. When the air has as much water as it can possibly hold we call it saturated, and in that condition we say it has one hundred per cent of humidity. Cold air requires less moisture to saturate it than warm air, hence elevation of temperature means increase of the saturating point.

It tells us that there is a constant variation going on—sometimes at short intervals, and at others in long periods ; and it further shows, as we are ready to anticipate, that there is a constant change in the capacity of the air and amount of moisture in it during the twenty-four hours of each day. As I take it, this atmospheric property plays an important part in our investigation of dust combustion.

In various localities the average capacity of the air varies considerably. "In the North American Continent," says Ganot in his admirable text-book on Physics, "where the south-west winds blow over large tracts of land, the relative moisture is less than in Europe ; evaporation is here far more rapid : clothes dry quickly, bread soon becomes hard ; newly built houses can be at once inhabited ; European pianos soon give way here, while American ones are very durable on the other side of the Atlantic. As regards the animal economy the liquids evaporate more rapidly, by which the circulation and the assimilation is accelerated, and the whole character is more nervous. In some parts of East Africa, on the other hand, the air is so charged with humidity that paper becomes soft and sloppy from the loss of its glaze, and gunpowder, if not hermetically sealed, refuses to ignite." As a suggestive thought incidentally to these statements :—Are not the greater number of mill explosions in districts over which a dry atmosphere is known generally to exist ? By the indications of this instrument we find regular changes during the day, there being maxima about 8 A.M. and 8 P.M., and minima about 3 A.M. and 3 P.M. The Signal Service record (Louisville) for a few days will suffice to show this fact :—

	6.25 A.M.	10.25 A.M.	2.25 P.M.	6.25 P.M.	10.25 P.M.
Aug. 1 ..	90	79	59	72	88
Aug. 2 ..	82	62	51	61	85
Aug. 3 ..	90	67	57	90	93

Construction.—The instrument in construction is simple, consisting of two delicate thermometers, one of which is kept saturated by a reservoir of water. As the air loses or gains in capacity to dissolve moisture evaporation takes place from the wet instrument. Proportionate to the capacity of the air to contain water will be the degree of evaporation, and the extent of evaporation is indicated by the lowering of temperature. Thus, by a very easily constructed table, showing the difference of temperature readings of the two thermometers, a pretty accurate estimate may be made of the amount of water necessary to produce saturation and the amount already contained therein. The instrument may be easily constructed or purchased for a few dollars at any first-class optician's. It should, however, be accurately adjusted and the scales properly constructed. I will not occupy your time in explaining further how the readings are made, as that information may be obtained from any good text-book on meteorology, but will at once proceed to detail records arrived at by its aid in my subsequent description.

Mill Fires.—The principles I have heretofore laid down, simple as they may appear, I felt convinced underlaid many of the fires and terrible explosions so disastrous to flour mills, and to their ignorance I conceived might be attributed at least some of the most awful catastrophes chronicled in our industries. Every year, to his sorrow, the mill-owner finds his risk of destruction of property and life growing greater, and I believe to-day there are insurance companies that would as soon grant a policy upon a gunpowder magazine or dynamite factory as to the proprietor of a flour mill. I determined to submit these principles to a rigid test. Accordingly, with hygrometer and note-book in hand, and the valuable co-operation of Mr. Chas. Ballard, a practical miller, I penetrated every crevice and chamber, from basement to roof, of one of the best-ordered mills in the country.*

I will not occupy your time in describing the various parts of an ordinary flour mill, but make use of the technical terms applied to the various localities. Suffice it to say that the mill in question has every modern improvement in milling machinery, is substantially constructed of brick, is run by steam-power, and well ventilated from all sides. The grain is received in the basement ; the first floor is devoted to gradual reduction mills, and the second and third floors to bolting machinery and purifiers of the most approved description. It has a capacity of 180 barrels per day.

Mathematics cannot err ; mark, now, the extraordinary records :—(See Table).

The first unexpected result we notice in these records is that the atmosphere in both grinding and bolting rooms is moister than the air outside. On closer examination I soon discovered the cause of this. Each set of rollers

* This mill is situated in Louisville, Ky., and owned by Messrs. Jones, Ballard, and Ballard.

used in reducing the grain, 22 in all, was heated, owing to the friction and resistance in crushing. By the heat thus generated the normal moisture of the wheat was continuously being evaporated, and escaped into the mill; the spouts near the rollers were bedewed with moisture and the flour doughed. Notwithstanding that the windows on all sides were open, and the ventilation as thorough as possible, the entire atmosphere of the mill was thus kept in a moist condition.

After carefully examining the purifiers, bolting chambers, wheat cleaners, and other machinery for the dangerous element of dry air, I came lastly to the dust shafts. As I have already stated, in this mill there are two of these—one used for collecting the dust from the wheat cleaning, which is carried to the basement and there collected in a dust-room; the other carries off the light refuse flour dust made in the first reduction of the grain. In making observations I found the amount of moisture in both these shafts, and the various parts of each one, differ so slightly that I did not deem it desirable to note the variation.

The Dust Shaft.—Could science speak plainer to us than in these facts? Recal the many mill fires and explosions that periodically visit us, and does not each narrative begin with the now easily interpreted incident, that destruction commenced at the dust shaft or in its vicinity? Here, month after month, streams of dry air, drier than the hot summer breezes, are urged with the velocity of a storm, depriving the wood and other combustible matter of its moisture, converting all that will burn into tinder-like fuel, dry air separating and buoying up the particles of drier dust until the fatal spark occurs and combustion ensues, with the explosive violence, alas, too well known now to need description.

I do not hold that mills are blown up by the dust alone in the shafts, but I do believe that the fires generally originate there, and the local explosion caused thereby is often sufficient to fill the entire atmosphere of a mill with lodged and loose dust. A second charge is thus prepared for combustion, and the grand explosion occurs.

Dust shafts are then danger centres. Can there be any longer doubt in your minds? Is it necessary for me to suggest that they should be well protected and solidly constructed? Dry air in a mill, I am inclined to think, is little less dangerous than coal-gas escaping in the air. Why make these shafts of light match boarding? Will you longer, in the face of these deductions, use gauze and canvas doors communicating with them and your mills? As I stood one day near by one of these doors my hygrometer showed the dangerous enemy stealing into the dust-charged atmosphere of the mill.

Having accepted the fact, which I take for granted is now settled in your minds, that the dust spouts and flour shafts are drier than the surrounding atmosphere, let us see if science can explain why this should be so. Nearly all dusts are well known to chemists to be hygroscopic in their character. Flour especially will divest moisture from the air. But we have seen also that in the process of grinding, by the heat generated in friction, a large amount of the normal moisture of the grain is driven off, and the subsequent heated flour must necessarily be abnormally deficient in water. The percentage of moisture in the dust shafts would be, of course, governed by the humidity of the external atmosphere, as we find it shown in the table set forth.

The Barometer.—There is another interesting relation between the dust and the atmosphere as its medium, which is at least worthy of a passing remark. Do you know that dust is sometimes lighter than at other times? More correctly, the atmosphere, in its variable density, causes the light particles of floating matter to become more or less buoyant. Let me illustrate the statement by a familiar incident: Have you not noticed at some times, generally on a dry day, how the smoke rising from the chimney will rise and be buoyed up in an almost vertical direction—how on those days the very dust in the roads

hangs about and refuses to settle? The barometer on these occasions will be high, showing that the air is dense. Another day the air will be charged with moisture; the smoke hangs about the ground, no dust in the air now, for the air is too light to buoy it up; the barometer is low and rain is probable. Is it only reasonable to infer that during a high barometer the lighter particles of flour are reluctant to settle, and, floating in the air, add to the many dangers of a flour mill? I make this brief allusion to a probable cause conducive to fire and explosion. Time will permit me to do no more.

Deductions.—Gentlemen, the accurate diagnosis of disease points to a line of remedy. Have we not enough information on the cause of dust explosion to suggest a mode of remedy? It may be that we have not yet gone to the bottom of the mysteries involved, but we have, I think, indications enough to adopt a line of treatment.

Let me, as I have presumed so far, in the interest of science suggest:

1. That dust rooms are dangerous centres, and should be built, if possible, of brick, as you would build a smoke stack, and all communicating shafts and doors be of sheet metal.

2. That, as in the long period of drought in summer nature moistens the dry forest with rain and dew, so our parching winds, constantly blown through shoots, shafts, and dust rooms, should be daily, if practicable, charged with vapour or steam.

3. Keep the mill free from superfluous dust and flour.

4. As dry air is the miller's enemy, let him learn to use the hygrometer, and on its indications adopt methods, as he may think best, to drive it from the many lurking places in his mill.

5. In dry weather, when the air is dense and thick with floating particles, let him not overwork or strain the capacity of production. Overtaxing work has often preceded disaster.

6. Never use open lights in the mill if it is possible to avoid them, and get as much ventilation as possible.

Conclusion.—Before concluding the subject I have attempted to lay before you, the course of events makes it necessary to add one more record. After I had formed the line of thought and made observations at Messrs. Ballard and Co.'s mill, an incident occurred that rivetted my interest, as I think it will yours. After hunting nature to the utmost limits of investigation, I was rewarded beyond measure in an occurrence which took place unexpectedly to all, but unfortunately for my friends in labour, the Messrs. Ballard.

When lecturing before the Millers' Association of Kentucky, I made the following remarks: "Could we have had a register of the state of the atmosphere in the unfortunate Washburn mill, Minneapolis, immediately preceding the explosion, I doubt not that it would have shown a marked absence of humidity." Science has permitted me to realise this, for on August 22, my closing record at the mill reads:

Date.	Hour.	External.		Interior.	Weather.
		Tempera- ture.	Hu- midity.		
Aug. 22	11 a.m.	82°	60	Wheat dust shaft and adjoining bin on bolting floor now in flames. Fire confined to upper portion of shaft, but fierce and destructive.	Fair

What originated the fire I pass uncommented upon. The fact that the dust shaft burned with rapidity, and that the entire mill was but a wreck from either the flames or explosion, I leave for your thoughtful consideration. On the spot where I had made my observation, in the wheat dust room, the last time I visited the building,

there remained only the ruins of property estimated from eight to ten thousand dollars.—*Journal of the Franklin Institute.*

NOTICES OF BOOKS.

Weights and Measures. Report by the Board of Trade on their Proceedings and Business under the Weights and Measures Act, 1881. 1882.

WEIGHTS and measures, though little noticed by the public at large, form a subject of great importance. They appear to require a very close supervision, and it appears doubtful whether the law confers in all cases sufficient power. Thus we read:—"Inspectors have lately complained that they find much fraud in the weight of made-up parcels, and that they have no power under the Act to enter shops and examine the weight of made-up quantities of goods offered for sale. The custom of trade sometimes, however, appears to sanction the sale of parcels of goods on which the specified weight, or measure, or number differs from the actual weight of the goods." Surely the law should not for a moment tolerate customary frauds to which the purchaser submits either from ignorance or because he is in the shopkeeper's debt. We may here note the existence of specially weighted papers used for wrapping up parcels of goods and weighed along with them.

Incorrect weights in the use of pharmacists are a source of danger to the public, overweight being here even worse than a deficiency. It is therefore not reassuring to learn that the St. Pancras inspector "lately visited 36 chemists' shops, and in nearly every case reported the weights, &c., unjust or incorrect." In Edinburgh a pharmaceutical chemist was fined for having unstamped and erroneous weights used in dispensing poisons. Of three 6-grain weights one was found one-tenth gr. too heavy, and the two others three-tenths gr. deficient, thus giving a range of error of four-tenths grain according as one or the other of these weights happened to be used. A one-grain weight was half-a-grain too heavy, and of three five-grain weights one was found to be three-tenths grain too heavy, and another nine-tenths grain deficient! Such variations are surely enough to gravely modify the nature of a prescription in case of physiologically active substances.

Nothing seems to have been done as regards the adoption of the metric system beyond the verification of metric standards for scientific purposes, and the official issue of new cards of equivalents of imperial and metric weights and measures.

In connection with the baking trade we have an instance of the "glorious uncertainty of the law." The Middlesex magistrates decided that an inspector could not enter a bakehouse to examine the weights, whilst about the same time the Hants magistrates convicted a baker for obstructing the inspector by denying him access to the bakehouse.

We find mention of hoped-for legislation for regulating the measures used in the sale of gas and for testing its illuminating power. This is an admission that in existing arrangements there is room for improvement.

As regards the testing of petroleum, Dr. Foerster, Director of the Imperial Standards Commission of Germany, has detected an important oversight. No allowance has hitherto been made for the variations of atmospheric pressure at the time of taking the flashing-point. It appears that a fall of the barometer, very naturally, lowers the flashing-point. Some oils recently tested in London, when the barometer marked 29.80 inches gave flashing-points of 89° and 74° F. respectively. When tested at Buxton with the barometer at 28.35 inches they flashed at 86° and 72° F.

It is also mentioned that samples of oil tested at Calcutta

gave a lower flashing-point than they had done at London and New York. This may possibly be due neither to the apparatus nor to the mode of using it, but simply to the circumstance that prolonged exposure to a high temperature previous to testing reduces the flashing-point of the oil.

Patent Safety Lamps, and Prevention of Explosions in Collieries. By W. CROSSLEY, M.I.C.E., F.C.S. Glasgow: P. Bertram.

THE author has adopted in his safety-lamp an entirely novel principle. He proposes to fix throughout coal-mines iron-piping similar to gas-piping, but conveying atmospheric air obtained from the outside of the mine. This air supports the combustion of the safety-lamp, which is thus not brought into contact with the atmosphere of the mine at all. There are at the top two specially contrived apertures for the escape of the products of combustion, which, before passing out, are cooled down so as to be incapable of igniting an explosive mixture. To prevent the air of the mine from forcing its way into the lamp the supply of air from outside the mine is forced into the lamp under pressure. Any attempt to disconnect the lamp so as to get at the flame extinguishes it at once. Another point, of apparently great importance, is its superior luminosity, so that the temptation to open the lamp in order to get a better light must disappear. The new lamp, indeed, is said to give nearly as much light as a photometric standard, and is consequently equal in efficiency to 8.00 Davy lamps (with gauze), 18.50 Stephenson's lamps, and 24.50 of the Upton and Roberts's pattern. Whether mine-managers will think it convenient to lay down a system of air-pipes in order to light up their workings on this system we cannot venture to guess. But we fear that the majority of explosions are due to the recklessness of the men who carry matches and tobacco-pipes down with them. After fatal explosions such articles are not unfrequently found concealed about the bodies of the dead.

Pollution of the Passaic River, embracing the Report of the Special Committee appointed to represent the Newark Aqueduct Board in the Board of Inspection of the Passaic River and its Tributaries. Newark, N.J.: Inglis and Co.

THE pollution of rivers is coming most unpleasantly to the front in the United States. This clever nineteenth century of ours has not yet found out how to carry on manufactures without filling air, water, and earth with nuisances, and if a community will make haste to grow rich it must accept the drawbacks which are so far closely linked with industrial progress. The Passaic River supplies, it appears, the important cities of Newark and Jersey with water for domestic consumption. Formerly the supply seems to have been satisfactory. But according to the analyses of Professor A. R. Leeds it contains 0.03 part of albumenoid ammonia, 0.444 of nitrates, and 0.39 of chlorine. Dr. Leeds, on examining samples taken at a series of points along the stream, notices the impurities introduced by refuse at Paterson. A very important point is "the extent to which the impurities introduced are oxidised and destroyed in the further course of the river. These oxidising effects are especially noticeable during the flow of seven miles." Thus just above Paterson the proportion of albumenoid ammonia was found to be 0.016 grain per gallon. Below Paterson it had risen to 0.068, whilst at Broadway Bridge it had sunk to 0.024, and at Dundee Dam to 0.018. These samples were taken in rapid succession on the same day.

These results confirm those obtained in the river Vesle, above and below Rheims, and prove that the conclusion formed by the late Royal Rivers' Pollution Commission, if true of certain excessively contaminated English streams, does not hold good universally. Professor Leeds seems

to be of opinion that with due care the waters of the Passaic may be restored to purity. It appears that among other nuisances complained of, the citizens of Newark were afflicted with the smell and taste of carbolic acid, which was found—as we can well imagine—especially unpleasant in tea. Judge McCarter, who tried the case, ruled that it was not necessary for the carbolic acid to be in poisonous quantity in order to constitute a punishable nuisance. "It is sufficient if it render the water offensive or disagreeable to the taste or smell."

Agenda du Chimiste. (The Chemist's Memorandum Book). Paris: Hachette et Cie. 1883.

THE object of this little book is to supply the chemist and technologist, within a small compass and in a convenient and methodical manner, with all the more frequently occurring numerical data required in every-day practice either in the laboratory or the workshop. The arrangement of the contents is somewhat similar to that of the English and German works of the same kind which we have already had occasion to notice, and much care has evidently been taken in bringing together such a heterogeneous mass of facts so as to render them reliable and convenient for use.

In Chapter I., which relates to physics and mathematics, are given many useful tables, such as for barometric and thermometric corrections, densities of solids, liquids, and gases, reductions employed in gas analyses for facilitating the calculations, melting- and boiling-points of some inorganic bodies, indices of refraction, &c.

Chapter II. is devoted to pure chemistry and contains data of frequent use in analyses by the wet and dry methods, factors for the calculation of analytical results, spectral and gas analyses. The most important section of this chapter contains the physical constants of a great many organic and inorganic bodies, their melting- and boiling-points, densities, and formulæ. The mineralogical table contains the characteristics of several hundred species arranged alphabetically, with their formulæ, hardness, crystalline form, and some of the important faces indicated with the hieroglyphic notation that finds favour with the French school of mineralogists.

Chapter III. contains many tables that will be of service to the technologist, as the composition of various alloys, glass, ceramic wares, and explosives, methods for the analysis of soaps, oils, butter, sugar, alcoholic liquids, manures, &c.

To the supplement to this edition of the "Agenda," M. Boussingault contributes a small notice on chocolate and cocoa, giving a description and the composition of specimens of these articles from different localities, and a few statistics of commercial value. Thermometric measurements and the determination of melting- and boiling-points is discussed by M. J. M. Crafts. M. G. Salet gives a short and concise notice of the transmission of force by electricity, and M. A. Henninger contributes an article on ferments and fermentation, in which an account of much of Pasteur's work is given, relating to conditions that affect the life of ferments.

This little work has now been before the chemical world for several years, and we have no doubt that although the English chemist has a book of reference of a similar kind in his own language its quality will still entitle it to a place amongst us.

Perfumes and Essences: a New Process of Industrial Extraction by Means of a Vacuum and a Low Temperature.—Laurent Naudin.—The author, after pointing out the defects of distillation, *enfleurage*, &c., proposes to extract perfumes by contact with a solvent, circulating in a somewhat complicated machine, which is here figured. Among the solvents used are alcohol, ethyl, and methyl chlorides, butyl and amyl hydrides, oils, glycerin, carbon disulphide.—*Moniteur Scientifique*.

CORRESPONDENCE.

ACID-RESISTING BRICKS.

To the Editor of the Chemical News.

SIR,—Our attention has lately been called to a report of a meeting of the Newcastle Chemical Society (CHEM. NEWS, vol. xlvii., p. 55), upon which occasion a paper was read by Mr. Morrison on "Acid-Resisting Bricks." The Welsh blue fire-bricks certainly obtain a very favourable opinion from him, but his remarks gave the impression that the use of these bricks in Glover's towers is a recent thing—a new discovery. To correct this idea we beg to refer your readers to Lünge's celebrated work on the subject, in which he specially recommends the Welsh blue bricks, under the name of "the blue bricks of Mold," for this particular purpose. We may also mention as an instance of their long-tried excellency that bricks supplied by ourselves to Messrs. Muspratt, of Flint, have been in use in a Glover's tower for thirteen years.—We are, &c.,

EDWARD PARRY AND SONS.

Buckley, Mold, March 20, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Bulletin de la Société Chimique de Paris.

No. 4, February 20, 1883.

Transformation of Carbon Oxysulphide into Ordinary Urea and Sulphurea.—M. Berthollet.—The author has already shown how carbon oxysulphide and ammoniacal gas form, by their combination, ammonium oxysulphocarbamate, which in turn is converted into urea by the simple elimination of hydrogen sulphide. This transformation is particularly sharp in presence of metallic oxides. On the other hand, by simply evaporating the aqueous solution in heat, there is produced a crystalline matter formed of urea, mixed with a smaller proportion of sulphurea and a little ammonium sulphocyanide.

Electrolysis of Oxygenated Water.—M. Berthelot.—Previously noticed.

Decomposition of Cyanogen.—M. Berthelot.—Already noticed.

Atomic Weight of Lanthanum.—P. T. Clève.—In 1874, the author made some determinations of the atomic weight of lanthanum by the synthesis of the sulphate. He found then that the anhydrous sulphate contained 57.619 per cent of La_2O_3 , whilst M. Marignac had shortly before obtained the closely approximating number 57.547, and M. Brauner subsequently found 57.549. All these values give in round numbers 139 as the atomic weight of lanthanum. More recent investigations have led M. Braunert to the atomic weight 138.28. These researches seem to denote the existence of a foreign oxide accompanying lanthanum. The author himself was at one time induced to admit the existence of such a body by the observation of a blue ray ($\lambda = 4333.5$) in the spectrum of the fractions intermediate between lanthanum and didymium, but a further examination proved that this ray belongs to lanthanum. To decide the question of the existence of this hypothetical body intermediate between lanthanum and didymium, the author has submitted mixtures of lanthanum and didymium to several series of partial precipitations by dilute ammonia. His results give for lanthanum the atomic weight 138.019 ($\text{O} = 15.9633 \pm 0.0035$). They show that lanthanum is not split up, and that its oxide

is a homogeneous body. The discrepancy with the author's former results may arise from the extreme difficulty of eliminating from the sulphate every trace of free sulphuric acid without setting up incipient decomposition. The only fraction which could contain a foreign earth is probably merely a mixture of didymium and lanthanum.

Journal de Pharmacie et de Chimie.
Tome vii., March, 1883.

Composition and Singular Properties of a Serous Pathological Liquid.—MM. J. Regnaud and Villejean.—This paper is rather of medical than of chemical interest.

Organic Synthesis and Thermo-chemistry.—M. Berthelot.—The author maintains that there is in the physical relations of carbon and of its compounds something peculiar which the other elements do not present. On examining the facts more closely he is led to think that the true element, carbon, is unknown, and that diamond, graphite, and the other varieties of carbon are substances of a different order. Elementary carbon ought to be gaseous at the ordinary temperature; the various kinds of carbon which occur in nature are in reality polymerised products of the true element, carbon. Spectral analysis seems to confirm this view; if into a Geissler tube we put any carbonised vapour or gas, carbon monoxide, cyanogen, carbon disulphide, &c., the spectro-scope shows two associated spectra. The one presents the rays of the body associated with carbon, whilst the other is the same whatever may be the compound of carbon examined. Hence it may be thought that this second spectrum belongs to gaseous carbon. This spectrum has been lately recognised along with that of hydrogen in the light of the tail of comets, which indicates a carbide, probably acetylene.

Action of Carbonic Acid upon a Solution of Neutral Lead Acetate.—Felix Bellamy.—In neutral solutions a current of carbonic acid produces a turbidity of lead carbonate, whilst the liquid becomes distinctly acid. In a quantitative experiment 77 per cent of the lead acetate was decomposed, yielding an equivalent quantity of lead carbonate.

Direct Determination of Sulphurous Acid and Hyponitric Acid in a Gaseous Mixture.—M. Quillart.—The author takes three tubes of glass, each 12 c.c. in length, of the width of test-tubes, connected together by smaller tubes and caoutchouc stoppers. The tubes are filled with asbestos saturated with a known weight of lead peroxide. The tubes, after being thus prepared and dried, are weighed exactly, and the dried mixture of sulphurous and hyponitric gases is passed slowly into the tubes by means of an aspirator, which at the same time measures the volume. The gases are totally absorbed, and the tubes are then weighed a second time. The increase of weight shows the exact weight of the known volume of the gases. To ascertain the weight of each separately, the plumbic asbestos is thrown into hot distilled water, a little pure barium carbonate is added, and the mixture is boiled. The barium carbonate completely decomposes the neutral and basic lead acetates, forming barium acetate, which is extracted by washing. The barium in the filtrate is determined as sulphate or carbonate in the ordinary manner, and from its weight the proportion of hyponitric acid is calculated. The weight of the latter, deducted from the increase of the weight of the tubes, gives the weight of the sulphurous acid.

Arsenic Acid recognised by the Silver Reaction.—E. Salkowski.—The author dissolves arsenic sulphide in fuming nitric acid, expels the greater part of the acid by evaporation, heats the residue with water, holding in suspension calcium or barium carbonate, and filters. Calcium and barium arseniates are sufficiently soluble for the filtrate to give a red precipitate on adding silver nitrate.

Moniteur Scientifique, Quesneville.
February, 1883.

Industrial Society of Mulhouse.—Session of December 13, 1882.—M. A. Scheurer read a report on the researches of M. Grosseteste on the weakening of cotton fibre under the influence of heat. M. Eugene Dollfus called attention to the action of chlorides present in size if submitted to a temperature of more than 100°. M. Albert Scheurer pointed out that a mixture of certain chlorides is dissociated more readily than any of them taken singly.

M. Noelting, in his own name and in that of M. A. Collin, communicated the results of certain experiments undertaken on the nitration of aromatic amines under different conditions. M. Noelting, along with M. Kobu, has also studied the products resulting from the action of diazo-derivatives upon paracresylol. He also announced that, in concert with M. Wild, he had prepared certain derivatives of aniline containing the radical isopropyl.

Patents taken Abroad.—The specifications of a number of chemical patents, relating chiefly to colouring-matters.

Metals of Cerite.—Dr. Bohuslav-Brauner.—This paper has appeared simultaneously in the *Journal of the Chemical Society*.

Considerations on the Doctrine of the Three Fundamental Fibres of Young as the Basis of a Theory of the Sensations of Colour.—M. Giraud-Teulon.—A purely physiological paper. The author considers Young's theory as being directly at issue with facts.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Nitrogen in Leather.—In the CHEMICAL NEWS, vol. xlvii., p. 131, I observe a paragraph as to "Decomposability of Nitrogenous Animal Matters." I am very anxious to know the author's conclusions as to the ground leather—a subject which has been much discussed in Scotland, especially compared with dried blood.—W. B. —[Of 100 parts of nitrogen in ground leather, 39.19 parts were rendered soluble by treatment with pepsine (which the authors think will in its solvent powers approach the action of ferment present in the soil, &c.). Of 100 parts ditto in dried blood, 89.75 parts were rendered soluble by the same process. The dried blood used in the authors' experiments contained 13.34 per cent total nitrogen, and the ground leather 6.91 per cent.—Ed. C.N.]

MEETINGS FOR THE WEEK.

- MONDAY, April 2.—Medical, 8.30.
— Society of Chemical Industry, 8. "The Stassfurt Salts and their Mode of Treatment," by Mr. C. Napier Hake.
— Royal Institution, 5. General Monthly Meeting.
TUESDAY, 3rd.—Institution of Civil Engineers, 8.
— Pathological, 8.30.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
WEDNESDAY, 4th.—Society of Arts, 8.
— Pharmaceutical, 8.
THURSDAY, 5th.—Chemical, 8. "Estimation of Hydrogen Sulphide and Carbonic Anhydride in Coal-Gas," by Mr. Lewis Wright.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Royal Institution, 3. "Art of Pheidias," by Dr. Waldstein.
FRIDAY, 6th.—Royal Institution, 8. "The Canons of the Far West," by Mr. A. Geikie, at 9.
— Geologists' Association, 8.
SATURDAY, 7th.—Royal Institution, 3. "Geographical Evolution," by Mr. A. Geikie.

ERRATA.—Page 125, col. 2, line 18 from top, for 0.500 read 0.550; p. 126, col. 1, line 42 from top, for 0.725 read 0.725; p. 127, col. 1, line 8 from top, for 0.290 read 0.280; p. 136, col. 2, line 3 from bottom, for 0.92 read 0.02.

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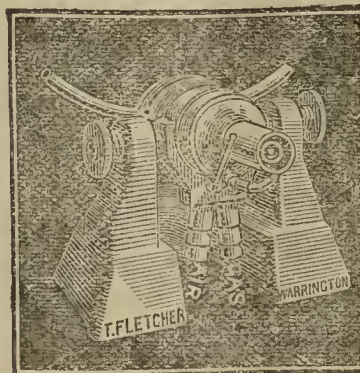
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1219.

PRELIMINARY NOTE ON THE INFLUENCE OF ABSORBED GASES UPON THE ELECTRICAL CONDUCTIVITY OF CARBON.

By I. PROBERT and ALFRED W. SOWARD.

It has long been known that carbon in the form of charcoal has the power of condensing gas within its pores. (Lametherie, *Journ. de Phys.*, xxx., 309; Morozzo, *Ibid.*, 1783, 376; *Nicholson's Journ.*, ix., 255, and x., 12; Rouppe and Van Noorden, *Ann. de Chim.*, xxxii., 3.) The exact experiments of De Saussure (*Ann. Phil.*, vi., 241 and 331) and of Hunter (*Phil. Mag.*, [4], xxv., 364, xxix., 116) show that the more readily the gas is reducible to the liquid state the greater is the quantity absorbed, and the experiments of Melsen (*Comptes Rendus*, lxxvi., 81, 92) prove that in some cases the absorbed gas is actually liquefied.

It is known that in the case of a pile of carbon powder the apparent resistance to the passage of an electric current is not a true resistance, but may be resolved into two factors—the real resistance of the carbon particles, and a disturbing influence traceable to the presence of gas filled spaces. In the case of a block of carbon, where cohesion exerts its power upon the particles, the spaces are smaller, and the disturbing influence due to them must consequently be less: but the spaces exist, as is evidenced by the experiments of Lametherie and others referred to above, and it is reasonable to suppose that the presence in these spaces of greatly condensed, and sometimes liquefied, gas must sensibly affect the electrical conductivity of the carbon. So far as we know, no experimental verification of this conclusion has been announced.

During the past year we have been conducting a series of experiments, in the course of which we have incidentally had the opportunity of measuring the electrical conductivity of specimens of a very porous variety of carbon in different gases at different pressures, and we have found that the conductivity is not a constant for a given temperature, but varies with the chemical nature and density of the absorbed gas.

Further (quantitative) experiments are in progress, the results of which we hope shortly to announce.

ON A NEW TEST FOR TITANIUM, AND THE FORMATION OF A NEW OXIDE OF THE METAL.

By EDWARD JACKSON.

If peroxide of hydrogen be added to an acid (HCl or H₂SO₄) solution of titanium a fine yellow or orange colour is developed, according to the strength of the titanium solution. This test is exceedingly delicate: a quantity so small as the 1-50,000th of a gm. in 1 gm. of the solvent can be easily detected. The test is valuable because it has hitherto been difficult to detect minute quantities of the metal, especially when mixed with iron, alumina, or silica.

Conversely, a solution of titanic oxide can be used as a test for peroxide of hydrogen, and is one of the most delicate and characteristic tests known for that substance. A quantity so small as 1-5000th of a gm. of a ten volume solution in 1 gm. of water can be easily detected by adding an excess of titanic oxide. A ten volume solution contains only

about 2 per cent H₂O₂, therefore 1-250,000th of a gramme of H₂O₂ can be detected.

As far as the writer knows there is only one other substance which gives a reaction with peroxide of hydrogen similar to titanic oxide, this other substance being molybdate of ammonia in nitric acid. Even here there is a difference in the colour, the latter being of a greenish yellow and the former of an orange yellow. The test with titanic oxide is much more delicate than with ammoniac molybdate, and the spectroscope distinguishes between the two coloured solutions easily, the former showing no blue or green in strong solutions, only orange and red remaining, with ammoniac molybdate the whole of the green and some of the blue is visible.

In applying the test certain precautions are necessary:—For instance, no colour will appear on adding peroxide of hydrogen to titanic oxide if a large quantity of hydrofluoric acid be present, though the colour may be developed on adding a larger excess of hydrochloric acid. Ferric chloride should also be absent, as the yellow colour may mask the colour of the titanium solution.

Believing that a new oxide was formed, the following investigations were undertaken:—

The highly coloured solution can be filtered without losing its colour.

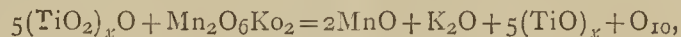
Ferrocyanide of potassium and tincture of nut-galls only gave a precipitate on long standing.

Reducing agents, such as Zn or SO₂FeO'', destroy the colour.

On neutralising the coloured solution with caustic or carbonated alkalies, or with ammonia or carbonate of magnesia, a pale lemon-coloured precipitate is thrown down. The precipitate may be washed with cold water, and on re-dissolving in dilute hydrochloric acid the colour will be restored in all its original intensity.

Heat destroys the colour, oxygen being evolved.

On adding a solution of potassic permanganate to the highly coloured solution both are decomposed, the resulting solution being colourless if mixed in the proper proportion. The chemical change probably takes place according to the equation—



the oxides of course being taken up by the free acid present.

The solution of the new oxide may be mixed with a solution of chromate of potassium without decomposition of either taking place. This is interesting, because it shows that the additional atom of oxygen is differently combined in the titanic oxide to what it is in peroxide of hydrogen: if an excess of peroxide be present all three substances are apparently reduced.

An attempt was next made to ascertain the composition, but this met with only partial success, indeed the composition seems to vary much, though this variation may be due to the washing the precipitate undergoes to free it from peroxide of hydrogen. The method adopted was to oxidise ferrous sulphate, ascertaining the end of the reaction by using ferricyanide of potassium as an indicator, and from the quantity of iron oxidised to calculate the composition. Very discordant results were obtained.

Another method was to ascertain the quantity of potassic permanganate a given quantity of the oxide of titanium would decompose, but no better success was met with, though it was ascertained that the quantity of iron oxidised and the quantity of permanganate decomposed were equivalent.

By using peroxide of hydrogen as a test, titanium has been found in places, the writer thinks, hitherto unsuspected. It is found in comparatively large quantities in the ash of coal. The writer has examined very many samples of coal, some of them from widely separated districts, and in every instance has succeeded in detecting titanium. In many cases the result was confirmed by concentrating and reducing with zinc, when the well-known and characteristic purple colour was developed.

In one estimation the quantity of titanite oxide so found was equal to about 0.1 per cent of the ash. The method of testing for titanium in the ash of coal is very simple. The ash, which should be well burnt, is heated with concentrated sulphuric acid to which a few drops of nitric acid has been added. The acid is next allowed to cool, and a large quantity of water added, filtered, and then tested with peroxide of hydrogen.

As coal is a vegetable product, it occurred to the writer that titanium might occur in the ash of plants. Accordingly some pine saw-dust was burnt, and the ash tested, when titanium was found. It has since been found in the seed of French bean, and in the ash from cotton seed cake. No further investigations have been made in this direction if we except two samples of soil which were examined, and in both of which titanium was found. It is just possible that the metal occurs in the bodies of animals, but this has not yet been put to the test.

In conclusion the writer would suggest that this colorimetric test may be made a quantitative one where only minute quantities of titanium have to be estimated, especially in certain qualities of steel to which titanium is added, but the whole subject wants working out, as only one or two experiments have been made in this direction.

ON INSENSIBILITY ARISING FROM A DEFICIENCY OF OXYGEN IN THE AIR.*

By WILLIAM WALLACE, Ph.D., F.R.S.E., F.I.C., F.C.S.

THE evil effects of breathing the air of crowded apartments were formerly ascribed to the existence in such air of an abnormal quantity of carbon dioxide, usually called carbonic acid gas, which was stated to be a deadly poison; but the views of chemists and physiologists in regard to this have been much modified of late years, and some authorities have gone so far as to express the opinion that it is not a poison at all, in the ordinary sense of the word. A little consideration will show that the effects resulting from breathing the air of a confined and over-crowded apartment cannot be due exclusively, or even chiefly, to the presence of carbonic acid gas; for that gas, as well as the aqueous vapour of the breath, is formed at the expense of the oxygen of the air, which diminishes in constant ratio to the increase of the products of the combustion of our food. For every per cent of carbonic acid gas produced, there is a little more than 1 per cent of oxygen taken up. Allowing, then, that carbonic acid is to some extent detrimental to the system when breathed, the effects to which I have referred are, at least partly, due to the diminished proportion of oxygen; and there is the further complication of an atmosphere saturated with aqueous vapour, and contaminated with the undefined volatile organic emanations from skin and lungs, which give a peculiar and oppressive feeling of "closeness" to the over-crowded and unventilated room. I think, however, that physiologists are now agreed that the lethargy, amounting in extreme cases to coma, produced by breathing such air, results from deficient oxygenation of the blood; and it is a fair inference that the most important factor in the phenomenon is the lessened proportion of oxygen. The normal proportion of that gas is from 20.9 to 21 per cent of the air when freed from aqueous vapour; and Dr. Angus Smith has shown conclusively that this proportion cannot be altered, even to the extent of $\frac{1}{4}$ per cent, without producing appreciable effects, while a loss of $\frac{1}{2}$ per cent gives rise to serious inconvenience, and air containing only 20 per cent of oxygen may produce grave consequences if breathed for a considerable time. On the other hand, a man can breathe, for a short time, an atmosphere containing only 16 per

cent of oxygen and about 4 per cent of carbonic acid gas. When the deficiency of oxygen exceeds this to a sensible extent a candle refuses to burn, and a man exposed to it is speedily overcome and becomes insensible.

In all ordinary instances of this kind there are the complications I have spoken of, and I have thought the Society would be interested in a case which came under my notice about six months since, in which there are no such complications.

In the construction of a railway-bridge over the Forth, near Alloa, a number of iron cylinders were sunk in sections or rings of 6 feet diameter and several feet in height, and making up in all, when finished, about 60 feet. I will not go into the mechanical details of the construction of the cylinders, except in so far as to say that the sections were placed one on the top of the other in such a way that a rather wide space was left all round, which had to be filled up from the inside with a rusting composition, well known to engineers, composed of iron turnings mixed with a small quantity of flowers of sulphur, with the addition, in some cases, of a little powdered sal-ammoniac. This mixture, when wetted with water, soon oxidises, and swells up so as to completely fill up the spaces into which it is thrust. At the Alloa bridge a considerable number of the cylinders had been erected, the most of the "rusting" having been done by one man, who mixed up the composition with water in a pail and applied it to the joints without being affected by it to any appreciable extent. On one day, however,—I think about the beginning of May,—when there was a perfectly still, somewhat hazy atmosphere, and considerable heat without direct sunshine, this man was observed to become overpowered by some mysterious influence, and a companion descended by a windlass on the top to bring him up. He managed to get him propped up in the bucket, in which he was pulled up to the fresh air, when he soon revived; but his deliverer was in turn overpowered, and, falling back into a pool of water at the bottom of the cylinder, was drowned. One of the contractors now descended, taking care to fasten a rope to his body in case he too might be rendered insensible by the noxious gas, which was now supposed to be present at the bottom of the cylinder; and fortunately so, for he speedily succumbed and was immediately pulled up by the rope.

On being consulted regarding this apparently mysterious occurrence, I at once saw that the theory of an accumulation of carbonic acid or other noxious gas at the bottom of the cylinder was untenable, for the bottom was covered with water, and no gas could have come up from the bed of the river without being seen bubbling through the water. A few experiments with the rusting composition, a quantity of which was supplied to me, clearly showed that it absorbed oxygen from the air with great rapidity, so that in one of my experiments a portion of air was deprived of its oxygen in ten minutes to such an extent that it would no longer support the combustion of a candle, and in two hours 16 per cent was absorbed. In another case, continued for a longer period, a loss of 20½ per cent occurred, or nearly the whole of the oxygen. At the same time the mixture became very warm, the temperature in one case rising to 156° F., while the iron oxidised and the mixture acquired a brown colour. I had no hesitation, therefore, in ascribing the accident to the absorption of the oxygen of the air in the cylinder by the rusting composition, coupled with the peculiar condition of the atmosphere, which, while it favoured chemical action between the oxygen and the iron and sulphur in the mixture, prevented the circulation of the air in the cylinder, which usually took place to a sufficient extent to prevent serious consequences. The deadly gas at the bottom of the cylinder was therefore nothing more nor less than the nitrogen which constitutes four-fifths of the bulk of our atmosphere, but which, deprived of its companion oxygen, is entirely unable to support respiration. We have in this unfortunate occurrence, by which one life was lost and others endangered, a justification of the German name of nitrogen,

* Read before the Philosophical Society of Glasgow.

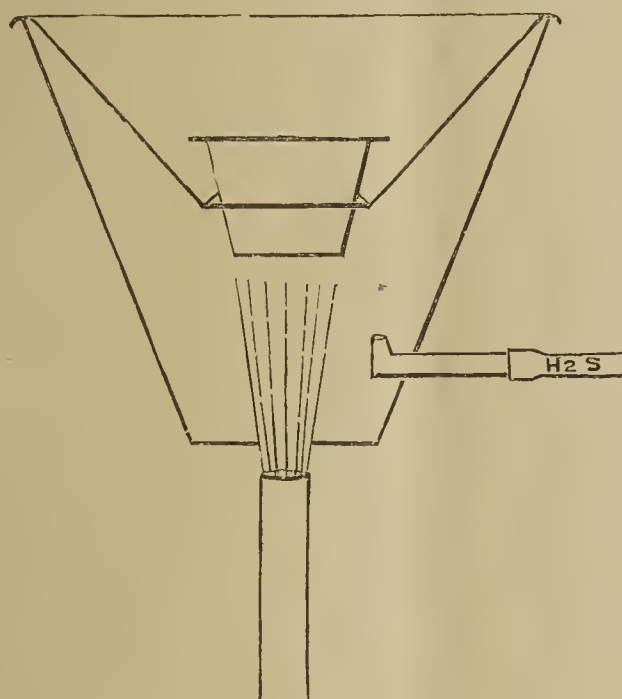
stickstoff,—which may be freely translated choke-stuff or choke-damp,—a name which in our language is applied exclusively to carbonic acid gas.

DETERMINATION OF ZINC AS ZnS.

By R. MACARTHUR.

THE solution, which should be as neutral as possible, is rendered alkaline with ammonia, add acetic acid till acid reaction, pass sulphuretted hydrogen through till the zinc is completely precipitated; allow to settle, carefully decant the clear liquid, then fill the beaker up with strong sulphuretted hydrogen water to which has been added a solution of ammoniac acetate, repeat twice, then transfer to filter, and dry. The ignition is performed as follows:—

A No. 6 Hessian crucible has a hole drilled through the bottom large enough to admit the flame from a Bunsen burner. About $\frac{1}{2}$ in. above the bottom a smaller hole is



drilled to admit a glass tube, which is bent upwards inside the crucible. The crucible in which the ignition is conducted is suspended in a triangle, about the centre of the Hessian crucible. When ready for ignition an energetic current of H_2S is passed through a drying tube, then through the glass tube into the crucible. The filter is ignited on the crucible lid, the flame of the lamp playing up through the large hole. Lastly, the crucible containing the ZnS is introduced, the lid put on, and ignited at a red-heat for ten minutes. Care must be taken to keep a steady stream of H_2S running.

By this method I have obtained the following per cent of same material:—No. 1. 92.180 per cent Zn; No. 2. 91.951 per cent Zn.

Philadelphia, March 18, 1883.

Improved Cock for Chemical Apparatus.—E. Hart. —This consists of two glass tubes, the one within the other, and connected by a piece of caoutchouc tubing drawn over both. The end of the narrower tube which projects into the wider one is closed at the lamp. At some distance from this end a lateral aperture is made with a file. If the narrower tube is drawn so far out of the wide one that the opening is closed by the caoutchouc tube, both are shut off from each other.—*Zeitschrift für Analytische Chemie.*

THE CHEMISTRY OF THE BESSEMER CONVERTER.*

ON Saturday evening, March 10th, Mr. J. E. Stead, F.I.C., F.C.S., the eminent metallurgical chemist, of the well-known firm of Pattinson and Stead, delivered an interesting Lecture before the Cleveland Iron Trade Foremen's Association, in their usual meeting-place in Corporation Road, Middlesbrough.

The Lecturer began by saying that the Bessemer converter was by far the most important metallurgical instrument of modern times. It had become even more important during the last few years, since the discovery and practical development of the Basic process, commonly called the Thomas-Gilchrist process, from the names of the inventors. By means of that system, as was well known, immense quantities of phosphoric pig-iron, which had before been deemed to be unsuitable for making steel, had been rendered, in a commercial as well as a chemical sense, available for the Bessemer process. This fact—for, notwithstanding the contrary opinions of some authorities, it was a fact—was of special importance to such districts as that of Cleveland, where there was made annually an enormous quantity of phosphoric pig-iron, which might by means of the new system be converted into excellent steel. He was going to speak to them that night of the chemistry of the Bessemer converter, and he would try to show them how the process was conducted, with what kind of material and what kind of steel was the result. He would also compare the ordinary or acid Bessemer process with the new basic system, pointing out their several differences both as regards method and materials used.

Before entering upon the chemical details the Lecturer exhibited upon a screen, by means of the oxy-hydrogen lantern, a series of views showing various kinds of Bessemer plants.

The material for lining the ordinary vessel was ganister, the composition of which he exhibited on the screen as follows:—

	Sheffield Ganister.		Good Mixture.
	No. 1.	No. 2.	No. 3.
Silica	85.0 p. ct.	92.0 p. ct.	91.2 p. ct.
Alumina	4.0 „	8.0 „	6.0 „
Peroxide of iron ..	1.5 „	2.5 „	1.7 „
Lime	0.1 „	0.3 „	0.25 „
Oxide of magnesia ..	0.3 „	0.5 „	0.25 „
Oxide of potassium ..	0.2 „	0.6 „	0.38 „
Oxide of sodium ..	0.3 „	0.4 „	0.32 „

What was wanted was a substance which would resist the action of very high heats, and be of such a plastic nature when damp as to hold together when placed in the converter. Thus it was very necessary to have about 6 per cent of alumina in the mixture, or otherwise it would be too sandy, and would be a useless mixture. It is very important that in choosing a ganister only such stones as are very free from the alkalis, potash, and soda should be selected, because these bodies—when present only in moderately large quantity—so affect the refractory properties of the bricks as to make them readily fusible at a high temperature.

The next slide gave the analysis of the material used for lining the vessels working on the basic system, as follows:—

Basic Linings.	
Lime	49.91 per cent.
Magnesia	30.72 „
Alumina	4.50 „
Oxide of iron	3.46 „
Silica	11.41 „
100.00	

* Revised and supplemented by the Author.

The noticeable feature of this was that, whereas in the ganister or acid lining the predominating constituent was silica, in the basic lining there was only 11 per cent of silica, the great bulk of the material being lime and magnesia. Different experimenters had experienced difficulty in using ordinary lime or limestone as refractory lining; but Messrs. Thomas and Gilchrist had succeeded at last in making a basic lining that would stand well. There were two or three ways of making good basic linings. The chief one was as follows:—Finely-ground magnesian limestone was moulded into bricks, which were then calcined in a kiln until all the carbonic acid was expelled and the substance had shrunk down to about half its original bulk: but they were in this stage ugly shapeless things, quite unfit for building up a lining, so they were taken to a mill and ground up to a rough powder. This powder was mixed with from 9 to 10 per cent of boiled coal-tar,—that is, tar from which the water has been all removed. If any quantity of water remained the lining would be liable to burst, owing to the slaking and consequent expansion of the lime in the composition. This mixture of tar and basic material is thrown in plastic lumps into an annular space which is formed in the interior of the vessel by the introduction of a cast-iron shell, within which a fire is placed. The basic material as soon as it becomes hot melts, and naturally fills up the annular space, and becomes quite solid after prolonged heating. Another method was to make bricks of this plastic material, in either cast- or wrought-iron moulds, which, while in their moulds, are placed in an oven and baked, when the tar is coked and the material becomes converted into solid bricks. After cooling, the mould is removed, and the bricks of perfect shape are simply built round the inside of the converter without any mortar whatever. When the vessel is ready molten pig is run in, and the converter being turned up the blow begins.

The following analyses of the metal charged during the ordinary acidic process were then exhibited:—

Metal used 15 years ago.			Metal used now.		
Carbon	..	3.5 to 4.0 per cent.	3.0 to 4.0 per cent.		
Manganese	0.1	,, 1.0	0.1	,, 1.0	,,
Silicon	..	2.0 ,, 3.0	2.0	,, 3.0	,,
Sulphur	..	0.01 ,, 0.05	0.05	,, 0.15	,,
Phosphorus	0.03	,, 0.10	0.03	,, 0.10	,,

The Lecturer pointed out that many years ago only such spiegeleisen as contained between 9 and 10 per cent of manganese was available for Bessemer purposes, and the amount of manganese which it was possible to add, without making the steel too hard, was limited. Consequently the metal was required to be particularly low in sulphur, for it was a well-known fact that the effect of sulphur upon steel is to make it red-short, so that it breaks when rolling. Manganese had precisely the reverse effect. The quantity of the latter required to neutralise the injurious effect of sulphur was from six to eight times its weight; and the old German spiegeleisen being capable only of adding from 0.35 to 0.4 per cent of manganese, it was clear that the metal to work well should not contain more than 0.05 per cent of sulphur. At the present time, however, since the manufacture of better class English spiegeleisen, as much as 20 per cent of manganese is obtained; and by increasing the proportion of manganese added to the steel a very much larger quantity of sulphur is admissible. Hence it is possible to make excellent steel now with metal which a few years ago would have been condemned as utterly unsuitable for Bessemer purposes. During the blow their first object was to rid the metal of its carbon and silicon, which was performed in from twenty to twenty-five minutes. The following approximate table was then shown:—

	At the Start.	After 5 mins.	10'.	15'.	20'.	25'.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	
Carbon	..	3.5	3.6	3.3	2.5	trace
Silicon	..	2.25	1.0	0.5	0.2	0.1
Manganese		1.00	0.35	0.2	trace	—

Thus they would see that the manganese all went in fifteen minutes; the silicon began to go immediately, and continued to burn away at about the same rate throughout, while the carbon did not begin to diminish appreciably until all the manganese had gone and nearly all the silicon. At first it seemed as though the carbon increased, but this was not so; the carbon remained about the same in amount, and, as the quantity of other things diminished, its proportion to the whole was of course increased.

The Lecturer then showed the following, which is a table similar to the foregoing, showing the action when very siliceous pig-iron is used:

	At the Start.	After 5 mins.	10'.	15'.	20'.	25'.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Carbon	..	3.5	3.6	3.3	2.5	1.0
Silicon	..	3.0	1.75	0.25	0.9	0.7
Manganese		0.75	0.25	trace	—	—

Here again it would be seen that the manganese disappeared first; the silicon began at once to go rapidly,—so rapidly, indeed, that the very great heat caused the carbon to commence to burn away sooner than usual, and the carbon disappeared almost while there was a small percentage of silicon yet remaining. This was what was called a hot blow, and it was desirable during a heat of this kind to add cold material. With such metal as this the blower is able, from previous knowledge, to ascertain a considerable time before the end of the process that the temperature is going to be excessive, and in such cases he reduces the temperature by the addition of cold scrap or pig-metal. When the temperature is not excessive the silicon entirely disappears before the carbon; consequently the whole of the oxygen entering at the bottom of the bath goes to burn the last traces of carbon, which is therefore very rapidly effected, and the large flame of carbonic oxide at the mouth of the vessel suddenly drops, indicating at once to the blower that the operation is ended. But when silicon is present during the elimination of the last traces of carbon, the flame does not drop so suddenly, for the oxygen is then divided in its action between silicon and carbon. Consequently the burning of the last parts of carbon is not so rapid, and the flame, instead of falling suddenly, fades gradually away. When this happens the blower knows that he has silicon left in the bath, and continues to blow until dense brown fumes appear, which is an indication that the oxygen entering at the tuyeres, after burning all the silicon, is commencing to burn the iron. The sulphur and the phosphorus in the ordinary acidic process are not affected to any extent; they apparently increase, but this is only relative, and is owing to the disappearance of the other ingredients. It would be observed, from the foregoing remarks, that as the temperature of the metal increases the relative attractions of silicon and carbon for oxygen approach each other. At first, when the metal is cool, the whole of the oxygen, practically speaking, is taken up by oxidising silicon; but after a certain period, when the temperature is considerably increased, the carbon begins to burn along with the silicon, and towards the end of the blow it will be seen, from the analysis of the siliceous blow, that the attraction of carbon for oxygen is as great or greater than that of silicon. This question of temperature is of the very greatest importance in making steel castings free from blowholes, for if the carbon has a greater attraction for oxygen than silicon has, the addition of silicon to the bath for the purpose of producing sound steel will be of no benefit whatever, and that the so-called Terrenoire process of making sound castings must necessarily depend as much upon the correct temperature of the metal as upon the chemical constituents.

The Lecturer here strongly advised that very much greater attention should be paid to the proper adjustment of temperature at the time of casting, in order that uniformly solid and homogeneous steel might be produced.

The Lecturer then turned his attention to the Basic

process, and exhibited upon the screen the following table, showing the composition of the metals commonly used in that process :—

Metals for Basic Process.

	No. 1.	No. 2.
Carbon ..	3'35 per cent.	3'50 per cent.
Manganese	0'60 "	1'00 "
Silicon ..	1'30 "	1'00 "
Sulphur ..	0'15 "	0'12 "
Phosphorus	1'75 "	2'75 "

As they would see, the special difference between this metal and that which was charged in the ordinary converter was the large percentage of phosphorus, and it was to effect the removal of this element that the basic system was called into existence. When the metal is charged into the vessel about 15 to 17 per cent of well-burned lime is also put in, for the purpose of absorbing the silica and phosphoric acid, produced by the oxidation of silicon and phosphorus, which, if no lime were present, would assert themselves by eating away the lining of the converter, which would in such a case be rapidly destroyed. Later on he would endeavour to explain why it was that the old process failed to remove the phosphorus. He then showed a table giving the approximate rates at which the various substances disappeared from phosphoric pig-iron during the blow :—

	At the Start.	After 5 mins.	10'.	15'.	18'.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Carbon ..	3'50	3'55	2'35	0'07	trace
Silicon ..	1'50	0'50	0'09	trace	—
Manganese ..	0'71	0'56	0'27	0'12	trace
Phosphorus ..	1'57	1'60	1'43	1'22	0'08
Sulphur ..	0'16	0'14	0'13	0'12	0'10

From this it would be seen that, as in the ordinary acid process, the carbon at first increases slightly, and afterwards rapidly burns away, while the silicon is speedily eliminated during the first few minutes of the blow. The manganese also is burnt out before the end of the operation, but not quite as rapidly as in the acid-lined vessel. Practically no phosphorus is eliminated until the whole of the carbon has been removed. The reactions which really take place in the basic process had been very carefully and systematically investigated by himself, and were of great interest to those concerned in the chemistry of the process. The Bessemer converter had always been classed as a great oxidising apparatus, and looking at it as a whole it was so; but it would be quite as logical to state that the blast-furnace, which they all considered to be a reducing machine, was also an oxidising apparatus. The fact was that they were both oxidising and reducing. In the blast-furnace the oxygen entering in at the tuyeres oxidised the carbon in the coke producing heat; but in the higher reaches of the furnace the gases so formed and the unoxidised carbon were very powerful reducing agents, and effected perfect reduction of the iron ore charged. In the Bessemer converter they also had a lower or oxidising part, and an upper reducing region. At the lower part, near the tuyeres, the oxygen rapidly entered into combination, not, as some would suppose, with the elements exactly as in the order shown in the ultimate analytical tables, but with the whole of the constituents all together in the proportion in which they were present, producing a very highly basic oxide of iron cinder. This cinder, passing upwards through the column of metal which—owing to the rushing of air through it—is in violent agitation, reacts upon the silicon and manganese, and at the same time also upon phosphorus, producing silicate of iron, silicate of manganese, and phosphate of iron. As the cinder was more and more intimately brought into contact with fresh portions of metal, the greater part of the oxide of iron was reduced, the iron returning to the bath at the same time that the silicon and manganese were

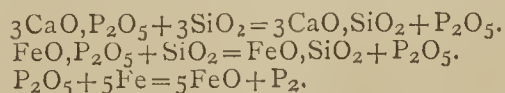
oxidised. These reactions might very briefly be described by means of chemical symbols, thus :—

1. $\text{Air} + \text{Fe} = \text{FeO} + \text{N}.$
2. $2\text{FeO} + \text{Si} = \text{SiO}_2 + \text{Fe}_2.$
3. $\text{FeO} + \text{Mn} = \text{MnO} + \text{Fe}.$
4. $6\text{FeO} + 2\text{P} = \text{FeO}, \text{P}_2\text{O}_5 + 5\text{Fe}.$
5. $\text{FeO}, \text{P}_2\text{O}_5 + 6\text{C} = \text{Fe} + \text{P}_2 + 6\text{CO}.$
6. $\text{FeO}, \text{P}_2\text{O}_5 + 3\text{Si} = 3\text{SiO}_2 + \text{P}_2 + \text{Fe}.$

It would be seen from the last two reactions, Nos. 5 and 6, that as long as carbon and silicon existed in the bath, there being a large head of metal over the tuyeres, practically no phosphorus could be eliminated. If, however, the bath was shallow, or the tuyeres were caused to inject air forcibly upon the surface of the metal, there being on the surface at the same time a quantity of lime ready to absorb any silicic or phosphoric acid produced, the phosphorus might be and had been perfectly removed before the elimination of the carbon. Thus at the Blaenavon Works, where Messrs. Thomas and Gilchrist made their first experiments in a stationary converter in which the tuyeres were certainly not more than a few inches from the surface of the metal, in almost every case the whole—or at least a very great proportion—of the phosphorus was eliminated by the time that the last portions of carbon were removed from the bath. The question might be asked why the oxide of iron produced by surface oxidation is not reduced, remembering that the metal during the blowing process must necessarily be in a violent state of agitation, and therefore brought into intimate contact with the cinder formed at the surface? The explanation was very simple. When the phosphate of iron was formed at the top of the bath it instantly afterwards came into contact with highly heated lime, which completely decomposed it, phosphate of iron and lime reacting on each other and forming phosphate of lime and free oxide of iron, and this phosphate of lime was incapable of reduction by the carbon in iron or by carbonic oxide gas. Hence no reduction took place. From the point of the termination of blowing forward the operations in the acid and basic processes were similar, only in the case of basic steel the greater part of the surplus oxygen contained in the bath was removed by Mr. E. W. Richards's process, of adding fluid hematite pig-iron containing silicon. To the blown metal was added spiegeleisen, by means of which the necessary carbon and manganese were put back into the metal (and by means of which, in the case of acidic steel, the surplus oxygen was also removed), which was thereby converted into malleable steel. The following analysis of spiegeleisen were then exhibited :—

	Old German.	New English.
Carbon ..	4'50 per cent.	5'20 per cent.
Manganese	10'00 "	20'00 "
Silicon ..	0'50 "	0'50 "
Sulphur ..	trace	trace
Phosphorus	0'10 "	0'10 "

The Lecturer then went on to explain the reason why phosphorus could not be removed in the ordinary silica or acid converter, and to make his explanation perfectly clear he placed upon the screen the following equations :—



These reactions showed that phosphate of iron or lime, if formed in the presence of silica, were decomposed, silicate of iron or lime being formed, and free phosphoric acid being produced. But this free phosphoric acid could not exist as such, but was reduced not only by the carbon and silicon, but even by the metallic iron itself. The Lecturer explained that if a rod of pure iron was simply dipped in phosphoric acid, and heated to redness while in contact with it, a fusible drop of phosphide of iron would form at the extremity of the rod.

The Lecturer then placed upon the screen comparative analyses of the slags produced in the two processes, which were as follows :—

	Ordinary Slag. Per cent.	Basic Slag. Per cent.
Protoxide of iron (FeO) ..	15.62	9.13
Peroxide of iron (Fe_2O_3) ..	1.57	—
Metallic iron (Fe)	—	—
Alumina (Al_2O_3)	1.02	2.10
Oxide of manganese (MnO) ..	5.33	4.32
Silica (SiO_2)	75.70	16.60
Lime (CaO)	0.94	47.08
Oxide of magnesia (MgO) ..	0.09	4.62
Sulphur (S)	0.01	0.12
Phosphoric acid (P_2O_5) ..	Nil.	16.03
Bases	14.57	65.15
Acids	75.71	34.85

Referring to the loss or waste in Bessemer converting, the Lecturer explained that a very great proportion of the present waste was due to projections from the nose of the vessel, which was liable to be carried away with the rubbish of the Bessemer house. An analysis of an accumulated mass of such projections was exhibited, as follows :—

Bessemer Projections.

	Per cent.
Free iron (Fe)	70.30
Peroxide of iron (Fe_2O_3) ..	14.50
Manganese (Mn)	0.11
Carbon	1.01
Silicon	0.63
Sand	13.18
Phosphorus	0.05
Sulphur	0.06

The Lecturer pointed out that, according to careful analytical data, not more than 2 per cent of the metallic iron in the charge was actually burnt, and that if no loss occurred, either in projections, scrap, or iron mechanically carried away entangled in the slag, the yield of steel should be 92.5 per cent of the metal charged. In practice, however, the yield averaged from 3 to 4 per cent less than this. In the basic converter the theoretical yield was about 2 per cent less than from the ordinary vessel, but in practice, owing to the large amount of slag produced, more particles of metallic iron were liable to be carried away with the slag, so that a yield of 85 per cent was considered very satisfactory.

The last slide exhibited was to show the comparative composition of Basic steel and ordinary Acidic steel, as follows :—

	Acid.	Basic.
Iron	98.33 per cent.	98.46 per cent.
Carbon ..	0.35 „	0.35 „
Manganese ..	1.11 „	1.01 „
Silicon ..	0.08 „	0.03 „
Sulphur ..	0.06 „	0.11 „
Phosphorus ..	0.05 „	0.04 „
Copper ..	0.02 „	trace

From these it would be seen that the steel produced is very similar in both cases.

In conclusion, the Lecturer remarked that the Basic process was making rapid progress in a commercial sense, not so much in this country (although there were several new works being arranged for the process near completion) as on the Continent. Mr. Gilchrist, one of the patentees, had recently estimated that the make of that steel last year, everywhere, was about half a million tons, and that the make of the forthcoming year would probably double that quantity.

Graphite-baths.—F. Stolba proposes graphite in place of sand, as it does not scratch glass vessels, and is more readily heated.—*Zeitschrift für Analytische Chemie.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Friday, March 30, 1883.

Dr. GILBERT, F.R.S., President, in the Chair.

THE PRESIDENT read his annual report. There have been occasions in the history of the Society when important questions had to be discussed, sometimes involving matters of internal working and management, at others the consideration of some new departure with a view to more extended usefulness. At present there are no such questions requiring special notice; the attainment of the objects for which the Society was founded is steadily progressing, and the President, taking advantage of the fact that he was elected a Fellow during the first session of the Society, now nearly forty-two years ago, presents the Society with a review of its progress from the commencement of its existence up to the present time. Of the 25 gentlemen who met on February 23, 1841, for the formation of the Society, only two now remain in the list of the Fellows, and out of the 118 members on the register at the first anniversary meeting, March 30, 1842, only 10 could now answer the roll-call—The President, Prof. Andrews, Drs. De la Rue, Longstaff, Lyon Playfair, James Young, and Messrs. Heisch, F. R. Hughes, Pearshall, and Denham Smith. The number of Fellows at the last anniversary was 1175; 104 have joined during the past session. Nine have died—Mr. John Gray, Mr. Dugald Campbell, Mr. J. J. B. J. Grosjean, Mr. A. Jesseman, Dr. G. A. C. Pearce, Dr. G. W. Septimus Piesse, Mr. E. Wilcock, Prof. H. J. S. Smith, and Mr. Frank Hatton; 23 have withdrawn, &c., so that the present number of Fellows on the register is 1247. One foreign member, F. Wöhler, is deceased, whilst nine have been elected, the total number of foreign members being now 37. The objects of the Society, as stated by the Founders, were the reading, discussion, and subsequent publication of original communications, and the formation of a chemical library and museum. The number of papers read during the five years ending 1846 was 167, giving an annual average of about 33; in 1854-55 only 17 papers were read; during the past session 70 papers were communicated to the Society, and one discourse, "On the Recent Development of the Theory of Dissociation," was given by Prof. Dewar. As to the Journal, 1775 copies were printed during the past year. About 1851, an attempt was made to found a museum in connection with the Society, and some specimens were sent from the great Exhibition, but were eventually again dispersed. The President suggests that as a nucleus of a future museum, the authors of papers on new compounds might be requested to present specimens to the Society. A much more favourable account can be given of the Library. At the time the last catalogue was issued to the Fellows in 1873, the number of volumes was 3540; since that time 3260 volumes have been added, making a total of 6800. During the same period the number of pamphlets has increased from 540 to 840. The Council have decided that a new catalogue arranged in order of subjects shall be prepared, printed, and issued to the Fellows as soon as possible. The income of the Society has steadily increased from about £183 in 1846 to over £3000. The Report then dwells upon the vast facilities for the study of chemistry which are now afforded in all parts of the country, so that while less than fifty years ago there was no systematic course of analytical training in the kingdom, now almost every public school has some arrangements for teaching practical chemistry. With this great development in the past, and all that it promises in the future, there is surely every reason to believe that the Society must increase both in the number of Fellows and in the

number and value of the papers communicated to it. There have been two off-shoots from the Society during the last few years—The Institute of Chemistry and the Society of Chemical Industry; but neither has prospered at the expense of the parent Society. The valuable papers which have been published by the Society of Chemical Industry have probably been originated altogether under the auspices of the new society, and are, so far, a pure gain, rather than a transference of energy. The President then concludes this portion of the Report with a most interesting *resumé* of the arrangements for chemical education and chemical research on the American Continent, founded upon the experience gained during his recent tour in that country, and on information received from Sir A. Galt, High Commissioner for Canada, and from His Excellency, Mr. Lowell, the American Minister in London.

Dr. SCHUNCK said that all must regret that Dr. Gilbert was not in a position to accept the office to which he had been nominated by the Council. The Fellows were much indebted to him for his constant attendance and courtesy. He had much pleasure in proposing a hearty vote of thanks to Dr. Gilbert, and that his report be adopted.

This was seconded by Prof. RONALDS and carried unanimously.

Dr. GILBERT said that he appreciated very highly the honour of having been President, and most sincerely regretted that in consequence of the pressure of his own avocation and his distance from London, he had been compelled to relinquish the office at the end of the first year. His successor was a tried officer of the Society, and had by his researches contributed largely to the interest of the meetings and of the Journal, and it seemed only fitting that a chemist who had devoted himself specially to organic chemistry should fill the Chair when that branch of the science was so constantly brought forward at the meetings of the Society.

The TREASURER then presented his Report. The total income of the Society was about £3073, the expenditure about £2770, leaving a surplus of £303. This surplus was rather smaller than last year for several reasons. There had been an increase in the expenses connected with the Journal of £217; with the Library of £61; the income was also rather less than was anticipated, owing to the fact that a smaller proportion than usual of the new Fellows had compounded. Next year there would probably be no surplus, as it would be taken up by the expenses connected with the new catalogue and the redecoration of the Society's rooms. The assets of the Society consisted of £7788 stock, and a balance at the Bank of £1194. As to the Research Fund, £220 had been given in grants during the year. The assets consist of £4500 stock, and a balance at the Bank of £166. The donations to the Fund had fallen off considerably.

Mr. WARINGTON proposed a vote of thanks to the Treasurer, which was seconded by Mr. MAKINS, and carried unanimously.

Votes of thanks were also given to the Auditors, the Council and Officers, and the Editor, Sub-editor, and Abstractors.

Messrs. W. Thorp and Newlands were then nominated Scrutators, and the following Officers and Council were declared duly elected:—

President—W. H. Perkin, Ph.D., F.R.S.

Vice-Presidents—F. A. Abel, Warren De la Rue, E. Frankland, J. H. Gilbert, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, H. E. Roscoe, A. W. Williamson, A. Crum-Brown, P. Griess, G. D. Liveing, J. E. Reynolds, E. Schunck, A. Voelcker.

Secretaries—H. E. Armstrong, J. Millar Thomson.

Foreign Secretary—Hugo Müller.

Treasurer—W. J. Russell.

Council—E. Atkinson, Capt. Abney, H. T. Brown, W. R. E. Hodgkinson, D. Howard, F. R. Japp, H. McLeod, G. H. Makins, R. Meldola, E. J. Mills, C. O'Sullivan, C. Schorlemmer.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, April 2, 1883.

GEORGE BUSK, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

ARTHUR GOULSTON, Jun., B.A. Cantab., and R. Raymond Mège were elected Members of the Royal Institution.

Three candidates for Membership were proposed for election.

The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

NOTICES OF BOOKS.

Programm der Königlichen Technischen Hochschule zu Aachen für das Studien Jahr, 1882-1883. (Programme of the Royal Technical High School at Aix-la-Chapelle.) Aachen: E. N. Palm.

THIS celebrated institution continues to flourish in undiminished efficiency. It is impossible to study the arrangements without feeling what a task lies before us if we wish to provide our practical men with a course of technological training such as is to be had in Germany. We are not in want of the needful funds, nor of qualified men as teachers, but so long as we cling to our peculiar notions concerning education,* all this profits, and can profit, us nothing. There are in the Aachen Technical School, five divisions, corresponding to the faculties in a university, and every pupil on entering has to select his faculty. The full course of instruction lasts four years. As in all German colleges, examinations, though occurring at the end of each year, are considered not as an end, but merely as a means of ascertaining the progress of the students. Turning to the Chemical Division, or faculty, we find that Professor Classen, assisted by Drs. Halberstadt and Bauer, gives instructions for four hours weekly in the summer term, and for one hour in forensic chemistry. In the winter term he gives one hour weekly in volumetric analysis, and two hours experimental chemistry. Practical work in chemistry, both qualitative and quantitative, is carried on daily in his laboratory from 8 a.m. to 6 p.m., except on Saturday. Professor Michaelis lectures six hours weekly on experimental chemistry, and his laboratory is also open for organic work from 8 a.m. to 6 p.m. Professor Stahlschmidt, assisted by Dr. Stengel, lectures on technical chemistry for four hours, on planning and arranging chemical works for four hours, whilst his laboratory is also open from 8 to 6 daily, except Saturday. Dr. Von Reis teaches technical gas analysis. Dr. La Coste lectures for two hours weekly on systematic organic chemistry, taking the fatty series in winter and the aromatic compounds in summer. He also reads the history of chemistry, and holds what is called a "chemical colloquium."

This brief outline may give some idea of the thoroughness which pervades the whole establishment, and may show what our technical schools, science colleges, &c., must equal, or, if possible, surpass, if we are to hold a fair position in the industrial world.

Dr. Theodor Schuchardt's Chemische Fabrik, Goerlitz. Winter Semester, 1882-83.

WE have here a catalogue and price list of the numerous chemical preparations produced in the celebrated establishment of Dr. Schuchardt. The number of the products offered for sale and the very reasonable prices of many rarities are worthy of notice. Experimentalists will therefore often find it of advantage to refer to this cata-

logue. A great inconvenience is that the author has seen fit to employ not the terminology of pure chemistry, but that of pharmacy. Thus the substances generally known as chlorides, iodides, bromides, &c., figure here as chlorates, iodates, and bromates; and, on the other hand, the compounds of chloric, iodic, and bromic acids figure, e.g., as natrium (sodium), chloricum, bromicum, &c. We should think that not a few mistakes must arise from this peculiarity.

The catalogue also includes lists of standard volumetric solution, given, fortunately, in good German, and not in *quasi* Latin; sets of analytical apparatus, among which we note a set for the detection of poisonous or hurtful pigments on paper hangings, wooden toys, confectionery, &c.; further collections of metals, of the elements, of fluorescent solutions; of preparations for spectroscopic examinations; sets of alkaloids, of coal-tar colours, physiological collections, select crystals, models of crystals, collections of rare vegetable drugs, collections of minerals, and volumetric and general chemical apparatus.

On the Part of Salicylic Acid in the Formation of Salts with Medicinal Bases. By A. SCHLUMBERGER. Paris: Felix Malteste et Cie.

THIS pamphlet, which is reprinted from the *Transactions* of the French Association for the Advancement of Sciences, is medical rather than chemical in its subjects and intentions. The author proposes that the salts of quinine, zinc, lithium, bismuth, iron, &c., for medicinal use should be formed not with the "traditional mineral acids," but with salicylic acid, or of some other antiseptic acid of the aromatic series.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.—Vol. xcvi., No. II, March 12, 1883.

Speed of the Explosive Wave.—M. Berthelot.—A mathematical paper, not suitable for abstraction.

A Crystalline Aluminium Borate from Siberia.—A. Damour.—This new mineral species has been found in the Soktoui mountains, near Adoun-Tchilon, by M. Jeremeiew, and has received the name Jeremeiewite. The author assigns it the formula $Al_2O_3 \cdot BO_3$, but it contains 4.08 per cent ferric oxide, and 0.70 potassa.

Polarisation of Diffracted Light.—M. Gouy.—This memoir requires the accompanying diagram.

Indices of Refraction of Gases under High Degrees of Pressure.—J. Chappuis and C. Rivière.—This paper does not admit of useful abstraction.

Production of Certain Crystalline Stannates.—A. Ditte.—A solution of potassium stannate poured into an excess of calcium chloride gives a white gelatinous precipitate, which at 100° changes into small, colourless, cubic crystals, containing 5 mols. of water. An anhydrous calcium stannate may be obtained in crystals by keeping a mixture of stannic oxide, calcium chloride, and a little lime at a white-red heat for several hours, washing the mass, and treating it with weak hydrochloric acid. The author has obtained strontium, barium, nickel, cobalt, zinc, silver, and copper stannates in crystals, all of which are insoluble in water, but in the hydrated state dissolve in dilute acids.

Ammoniacal Bromides and Zinc Oxy-bromides.—G. André.—The author gives the method of preparation

and the analysis of several zinc ammonium bromides, and of three oxy-bromides of the same metal.

Double Ortho-Phosphates of Barium and Potassium, and of Barium and Sodium.—A. de Schulten.—The author obtains these compounds by heating to a boil a mixture of alkaline silicate and of baryta water, and then adds a solution of alkaline silicate holding a certain quantity of alkaline phosphate in solution. On cooling the liquid the new compounds are obtained in crystals. If caustic alkali is used instead of the silicate the product is an amorphous precipitate.

Chromium Selenite.—C. Taquet.—On treating chromium chloride at a boil with potassium selenite the author obtained a pale green, bulky precipitate, which, when washed and dried, has the composition $Cr_2O_3 \cdot 3SeO_2$. It is soluble in hot hydrochloric acid, insoluble, or scarcely soluble, in water, and slightly soluble in a boiling excess of selenious acid.

Vapour-Tensions of Ethylamine and Diethylamine Hydrosulphates.—M. Isambert.—The author refers to his paper, *Comptes Rendus*, xciv., p. 958, where he shows that the vapour-tension of ammonium hydrocyanate in presence of an excess of hydrocyanic acid, is the same as that of free hydrocyanic acid at all temperatures, notwithstanding the presence in the vapour of free or combined ammoniacal gas. He finds that with diethylamine hydrosulphate the law is the same, but with the ethylamine compound the results are strikingly different.

Salts formed by Glycolic Acid.—M. de Forcrand.—Glycolic acid forms with bases, three series of salts,—neutral salts, stable in presence of water; acid salts, decomposable in great part by water; and basic salts, which are at the same time neutral salts and alcoholates, and are decomposed by water, like the acid salts.

An Aromatic Tribrom-hydrine.—A. Colson.—The author has obtained and examined three compounds produced on treating mesitylene by bromine.

Mechanism of the "Setting" of Gypsum.—H. le Chatellier.—This setting is the result of two distinct, though simultaneous, phenomena. On the one hand, portions of anhydrous calcium sulphate, when moistened with water, dissolve as they are hydrated, forming a supersaturated solution. On the other hand, this same solution deposits crystals of the hydrated sulphate, gradually augment in bulk, and unite together.

Moniteur Scientifique, Quesneville.
February, 1883.

Industrial Review.—An account of various industrial processes, taken from the *CHEMICAL NEWS*, the *Journal of the Society of Chemical Industry*, *Liebig's Annalen*, &c.

Carbides of Petroleum as Sources of Benzol, Naphthaline, and Anthracene.—Professor Liebermann.—This memoir refers chiefly to the petroleum of the Caucasus. The firm of Nobel Bros., of Baku, have erected extensive works for obtaining the above products from petroleum refuse. They calculate for the present year upon producing 42,000 kilos. of crude anthracene, and 500,000 kilos. of benzol at 80 per cent.

A New Method of Carburetting Lighting-Gas.—A. Remont.—The agent used is naphthaline purified in a peculiar manner, patented by MM. Vale and Roosevelt.

The remaining papers in this issue are taken from the *Zeitschrift für Analytische Chemie*, and have been or will be duly noticed under that head.

Zeitschrift für Analytische Chemie.
Vol. xxii., Part I, 1883.

New Method of Separating Vanadic Acid from Metals.—W. Halberstadt.—Already noticed.

Method for Determining Hydrochloric, Hydrobromic, and Hydriodic Acids in Solutions which Contain Sulphuretted Hydrogen.—Haldor Topsoe.—This paper will be inserted at length.

Separation of Strontium and Calcium.—D. Sidersky.—The author's method is carried out as follows:—A few grms. of the sample in question (*e.g.*, finely-ground strontianite) are dissolved in a roomy beaker in a minimum of hydrochloric acid, and boiled for a time; all the strontia, including that combined with silicic acid, is dissolved, whilst gelatinous silica is deposited. Ammonia in excess is next added, which precipitates oxide of iron and alumina, and the residue of the silica. This deposit is collected on a filter, washed with a minimum of water, dried, &c., and accounted for as "marl." The separate determination of its ingredients is of no practical importance. The filtrate must be concentrated on the water-bath, and mixed whilst warm with a mixture of ammonium oxalate and sulphate (prepared by dissolving 200 grms. sulphate and 30 oxalate in 1 litre of water), which throws down strontium sulphate and calcium oxalate. A large excess of the reagent is to be avoided. The precipitate is carefully brought upon a filter, washed first with warm water, and then with dilute hydrochloric acid, which dissolves calcium oxalate, leaving strontium sulphate behind. The latter is washed to remove the acid, dried, ignited, and weighed. The filtrate is mixed with ammonium oxalate in excess, whereby the calcium oxalate is re-precipitated. It is then washed, dried, converted into caustic lime by ignition over the blast-lamp, and weighed.

Quantitative Analysis of Human Milk with an Appendix on Cow's Milk.—Dr. E. Pfeiffer.—The author determines the caseine by precipitation with about 3 drops hydrochloric acid (of sp. gr. 1.0020) to 2 c.c. The tube containing the milk should be plunged into water at about 62° to 68°. If the first drops pass through the filter turbid they are returned to the tube well shaken up, and again poured upon the filter. When all has passed through clear, the filter is dried, freed from fat in a Soxhlet-Szombathy ether apparatus, dried again, and weighed. The determination of the albumen is effected by boiling the filtrate obtained in the last operation. The coagulum is filtered off, washed, dried, and weighed. In the filtrate the "albumenoid residue" is determined by adding a few c.c. of a 10 per cent solution of tannin. This residue is not a peculiarity of human milk. In cow's milk the author found—caseine, 2.329 per cent; albumen, 0.224; and albumenoid residue, 0.731 per cent.

A New Method for Determining Nitric Oxide or Nitric Acid.—Dr. C. Böhrer.

Proposed Method for Determining Carbonic Acid and Nitrogen in Certain Combinations.—K. Söndén.—These two papers require the accompanying illustrations.

A Burette for Liquids which Attack Caoutchouc.—Karl Abraham.

Separating Funnel and Apparatus for the Determination of Fat.—A. Gawalowski.—Neither of the above two memoirs can be usefully abstracted without the accompanying illustrations.

Preservation of Ferrous Sulphate.—A. Gawalowski.—The author plunges in among the crystals a very stout test-tube, half filled with an alkaline solution of pyrogallic acid, and with its mouth sufficiently high above the mass. If the bottle is well stoppered, a sample so protected remains unaltered for two or three years.

Examination of Liqueurs.—Dr. J. Nessler and Dr. M. Barth.—The authors treat at length of the cherry and sloe brandies of Baden, the method of distillation, the different qualities, and the determination of alcohol, acids, lime, copper, and hydrocyanic acid. Copper may be present to the extent of 18 m.grms. per litre, the quantity being greatest when much acetic acid has been formed during the fermentation.

Determination of the End of the Reaction with Fehling's Solution in very Dilute Solutions of Sugar.—Dr. J. Moritz.—The author passes one or two drops of the liquid through a small filter upon a white porcelain plate, and tests for copper in the usual manner with acetic acid and potassium ferrocyanide. If there remains the slightest trace of undecomposed salt of cupric oxide, there is formed a reddish brown film of copper ferrocyanide, which shows very distinctly against the white plate.

Interference of the Salts of the Alkaline Earths with the Sulphocyanide Iron Reaction.—Hermann Weber.—The author had treated a residue containing potassium chlorate and chloride, calcium chloride, and traces of iron with nitric acid in order to oxidise the latter, and had heated the liquid until all chlorine was expelled. When the liquid was cold it gave the usual reaction with potassium ferrocyanide, but not with sulphocyanide. Further experiments showed that the chlorides of the alkaline earths enfeeble the reaction of the sulphocyanides with iron, and if present in excess can prevent it altogether. Calcium chloride has a more powerful action than the corresponding salts of strontium and barium. The nitrates of the alkaline earths interfere also, but in a slighter degree.

Analysis of Natural Wines.—R. Fresenius and E. Bergmann.—The authors determine the proportion of the various ingredients of wines to each other, showing the limits within which they may vary.

The Relation between Glycerin and Alcohol in Wine.—E. Bergmann.—Wines in which the glycerin bears a less proportion to the alcohol than 7 : 100 may be regarded as artificially fortified.

Washing Bottle for Hot Water.—E. Bergmann.—This short notice requires the accompanying figure.

Different Spectra of the Non-Metals.—D. van Monckhoven.—From the *Comptes Rendus*.

The Capacity of Gases for Absorbing Heat.—H. Heine.—The author has sought to utilise this capacity for determining the constituents of gaseous mixtures.

Mechanical Separation of Different Minerals.—C. Dölter.—The author makes use of an electro-magnet, regulating its power according to the case. He notes that iron sulphides, sulphates, and carbonates are attracted less strongly than the oxides, carbonates, and silicates. L. Pebal considers it preferable to apply magnetic action to powders suspended in water, instead of operating, as does Dölter, on the dry powder.

Combustion of Carbon in Organic Incinerations.—E. Johanson.—The author proposes when the carbon is glowing to let the crucible cool until the incandescence ceases, and heat again, alternating in this manner until the ash is of a pure white. The process is said to be thus effected more rapidly than by continuous ignition.

New Wedge Compensation in Polarising Apparatus.—Schmidt H. Hänsch.—For a description of this apparatus the reader is referred to the original memoir.

Covering-glasses in the Tubes of Polarising Apparatus.—W. Poppe.—The author calls attention to the known fact that covering-plates if too strongly pressed become double refractive.

Balances and Weighing.—W. Dittmar discusses theoretically the factors on which the sensitiveness of the chemical balance depends, and in another memoir describes a microscopic arrangement for reading off the indications of sensitive balances.

W. J. Marck treats of the effect of small differences of pressure upon the results of delicate weighings and measurements.

G. Schwirkus points out that in reducing determinations of weight to a vacuum the specific gravity of pure air is taken as a basis, whilst the weighing is generally performed in air modified by the products of human respiration, the combustion of lamps, &c. He also considers

the influence of the porosity of weights upon their permanence. He also proposes a new method of fixing the knife-edges, which he explains by a figure.

L. Löwenherz considers the torsion of wires as a means of determining small weights.

F. Sartorius proposes a new apparatus for checking oscillation.

Paul Bunge has constructed an analytical steel-yard, which is said to be not inferior in sensibility to the ordinary balance, whilst much less time is required in weighing.

Thermometers.—MM. Pernet, Crafts, E. J. Mills, T. E. Thorpe, A. W. Rücker, and others, have proposed modifications in thermometers, or studied the defects of the instruments now in use.

L. W. Andrews describes and figures a thermometer for temperatures extending above the mercurial scale.

Determination of Melting-points.—Guichard melts the substance in question, sucks it into a capillary tube open at both ends and slightly widened at top up to the middle, and allows it to congeal. The space above is then filled with a coloured liquid which does not attack the substance, and the little tube is heated along with the thermometer in the usual manner. At the moment of melting, the coloured fluid runs off, and the temperature is read off. It is questionable whether, in many cases, the efflux may not be hindered by capillarity.

The arrangement of Messrs. C. F. Cross and E. J. Bevan is described in the *CHEMICAL NEWS*, vol. xlv., p. 39.

L. Liebermann, for determining the melting-points of alloys, plunges rods of the substance in question into a paraffin-bath, and includes them by means of wires in a galvanic circuit, into which a signal bell is introduced. As soon as the metal melts, the current is interrupted, the bell is silent, and the thermometer is read off.

Determination of Vapour-densities.—L. Valente proposes a modification of V. Meyer's apparatus. At the upper end of the tube projecting up out of the heating apparatus, a thick caoutchouc tube is fixed, closed below by an ordinary and above by a screw pinch-cock. Between the two is the small glass tube containing the substance. When the apparatus has reached the requisite temperature, the lower pinch-cock is opened, and the tube with its contents falls into the recipient.

Determination of the Specific Gravity of Liquids at their Boiling-point.—R. Schiff proposes modifications in the apparatus of Ramsay, described *Zeitschrift Anal. Chemie*, xix., 60.

Apparatus for Determining Solubilities at Different Temperatures.—F. Stolba.—The reader is referred to the original memoir (*Chem. Central-Blatt*, Series 3, vol. xi., p. 773).

New Gas Blast Lamp.—T. T. Morell.—From *New Remedies*.

A Modification of Weber's Mercurial Distillation Apparatus.—A. W. Wright.—From the *CHEMICAL NEWS*.

Filtering Apparatus.—P. Casamajor.—From the *CHEMICAL NEWS*.

A Water-bath with a Constant Level.—F. Schimmel.—The boiling vessel is connected with a closed reservoir by two tubes in the same manner as in arrangements for the continuous washing of precipitates.

Preservation of Objects of Vulcanised Caoutchouc.—W. Hempel.—The author proposes to keep them in large glass boxes in which there is an open vessel of petroleum.

Preparation of a Durable Starch Solution for Iodometry.—A. Müller rubs up the starch with strong potassa lye. On diluting with water a clear solution is obtained which keeps for years. When using it care must be taken that the liquid to be titrated contains a slight excess of acid.

Preparation of Durable Tincture of Litmus.—Tincture prepared according to Mohr's formula is evapo-

rated to dryness, and the residue is dissolved in a little glycerin. For use a glass rod is introduced into the tincture, and the liquid to be coloured is stirred with it.

Purification of Zinc.—To expel arsenic Selmi melts the zinc in a crucible, and throws in a piece of sal-ammoniac. All the arsenic passes off as arsenious chloride.

Preparation of Pure Silver Nitrate from Cupriforous Silver.—The alloy is dissolved in nitric acid, evaporated to dryness, melted, and reduced silver is stirred in as long as effervescence takes place. The copper is separated out, and silver takes its place, so that pure silver nitrate may be dissolved out and crystallised.

Evolution of Sulphuretted Hydrogen Gas.—A. Lidoff.—The author heats sulphur to the point of incipient sublimation in a suitable flask, and allows liquid oleonaphtha to flow in at the rate of 3 to 5 drops per minute. A rapid and regular emission of sulphuretted hydrogen is thus obtained.

The Permanence of Standard Solutions of Alkaline Hydrosulphites.—Spencer Umfreville Pickering.—From the *CHEMICAL NEWS*.

Methods of Preparing and Applying Molybdic Solution.—H. Kupferschlaeger.—From the *Bulletin de la Soc. Chimique de Paris*.

Preparation of Hydrobromic Acid, and its Use in Analytical Chemistry.—August Harding.—The author describes and figures an apparatus by means of which about 1 kilo. concentrated acid can be prepared per hour at about one-sixth the cost of the commercial product. The acid dissolves all the simple metallic sulphides, whether natural or artificial; if moderately strong it dissolves mercury, copper, and lead, with liberation of hydrogen gas, whilst the strongest acid dissolves considerable quantities of lead sulphide, which is re-precipitated on dilution with water. Hydrobromic acid is especially valuable for the determination of sulphur. In presence of pieces of amalgamated copper it converts sulphur, whether free or in the form of metallic sulphides, into hydrogen sulphide, which, if no carbonic acid is present, is dried over calcium chloride, and absorbed in a weighed soda-lime tube.

Detection of Carbon Monoxide.—J. v. Fodor.—A slip of Swedish filter-paper, saturated with a neutral solution of palladious chloride, turns grey on contact with carbon monoxide. The author mentions that hydrogen sulphide and ammonia produce the same colouration. Böttger also states that marsh-gas, ethylene, hydrogen, and coal-gas, also act upon the test-paper, whilst it is not affected by oxygen, nitrogen, carbon dioxide, and sulphur dioxide. Schneider confirms Böttger's statements, and remarks that in addition hydrogen sulphide, ammonium sulphide, and ozone blacken the palladium paper, whilst chlorine, hydrocyanic acid, nitrous acid, and ammonia produce no effect. We have here a contradiction of Fodor's results as far as ammonia is concerned, whence palladium chloride can only be used with caution as a reagent for carbon monoxide.

Determination of Alkaline Chlorides in Presence of an Excess of Magnesium Sulphate.—H. Precht and B. Wittjen.—The mixture is ignited with starch. The alkaline sulphides formed are easily extracted from the residue by lixiviation, whilst the magnesia remains undissolved.

Determination of Lithium in Presence of Excess of Potassium and Sodium Chlorides.—W. F. Gintl.—The author adds to the mixture 4 to 5 times its weight of hydrochloric acid, and heats for two hours on the water-bath, adding more acid to make up for the loss on evaporation. When cold the solution is decanted through a glass-wool filter which has been previously washed with hydrochloric acid. The residue is treated twice more with hydrochloric acid in the same manner, so as finally to bring the entire saline mass upon the filter, where it is washed with hydrochloric acid until a drop of

the liquid passing through no longer shows the presence of lithium when examined with the spectroscope. The filtrate is evaporated on the water-bath to 1-20th of its original volume; about 3 parts of concentrated hydrochloric acid are added, and the sodium and potassium chlorides which separate out are removed by means of a glass-wool filter. The saline mixture is washed with a minimum of hydrochloric acid until the lithium reaction disappears. The solution obtained is freed from hydrochloric acid by evaporation, and contains all the lithium along with little potassium and less sodium. The lithium can then be determined as a basic phosphate in the ordinary manner.

MISCELLANEOUS.

Distillation in a Vacuum.—H. Schüller has observed the behaviour of 13 inorganic and 12 organic bodies when heated in a vacuum, their sublimations and distillations, and the nature of the residues. Many of the elements examined, especially selenium, tellurium, cadmium, zinc, magnesium, arsenic, and antimony, were capable of sublimation, while the very fusible metals, bismuth, lead, and tin, distilled with difficulty, the last-mentioned scarcely at a red heat. On the other hand, Demarcay found bismuth volatile at 292° , lead and tin at 360° , which Schüller explains by the presence of volatile impurities. During the whole time of the distillation of a metal an escape of gas was observed. But on repeated evaporation this phenomenon was imperceptible, or very slight. Sodium, selenium, tellurium, cadmium, zinc, arsenic, and antimony evaporate so readily in a vacuum that this method may be used for their purification. Amongst organic bodies many unstable mixtures, such as tallow, wax, and resin, distil so easily in a vacuum that they may thus be separated from impurities.—*Annalen der Physik*, N. S., xviii., p. 317.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Anhydrous Ammonia.—Can any of your readers furnish information as to the manufacturers of anhydrous ammonia? At atmospheric pressure it will of course be a gas, but under greater pressure a liquid.—T. P.

MEETINGS FOR THE WEEK

- MONDAY, April 9.—Medical, 8.30.
— Society of Arts, 8. Cantor Lectures. "The Decorative Treatment of Metal in Architecture," by George H. Birch, A.R.I.B.A.
TUESDAY, 10th.—Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8.30.
— Photographic, 8.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
WEDNESDAY, 11th.—Society of Arts, 8. "The Portrush Railway and the Transmission of Power by Electricity," by Alexander Siemens and E. Hopkinson, D.Sc.
— Geological, 8.
— Microscopical, 8.
THURSDAY, 12th.—Royal Institution, 3. "Art of Pheidias," by Dr. Waldstein.
— Society of Arts, 8. "The Formation of Diastase from Grain by Moulds," by R. W. Atkinson, B.Sc.
FRIDAY, 13th.—Royal Institution, 8. "Influence of Athletic Games on Greek Art," by Dr. Waldstein, at 9.
— Astronomical, 8.
— Quekett Club, 8.
SATURDAY, 14th.—Royal Institution, 3. "Geographical Evolution," by Mr. A. Geikie.
— Physical, 3. "Some Uses of a New Projection Lantern.—Science Demonstration in Board Schools," by W. Lant Carpenter. "Experiments on the Viscosity of Saponine," by W. H. Stokes and A. E. Wilson.

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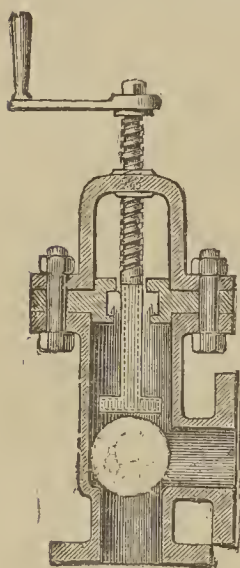
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1220.

RE-CONVERSION OF NITRO-GLYCERIN INTO GLYCERIN.

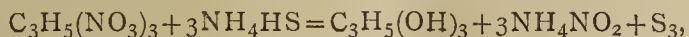
By C. L. BLOXAM.

THE following experiments on this subject appear to possess some interest at the present moment:—

1. Nitro-glycerin was shaken with methylated alcohol, which dissolves it readily, and the solution was mixed with an alcoholic solution of KHS (prepared by dissolving KHO in methylated spirit, and saturating with H_2S gas). Considerable rise of temperature took place, the liquid became red, a large quantity of sulphur separated, and the nitro-glycerin was entirely decomposed.

2. Nitro-glycerin was shaken with a strong aqueous solution of commercial K_2S . The same changes were observed as in (1), but the rise of temperature was not so great, and the liquid became opaque very suddenly when the decomposition of the nitro-glycerin was completed.

3. The ordinary yellow solution of ammonium sulphide used in the laboratory had the same effect as the K_2S . In this case the mixture was evaporated to dryness on the steam-bath, when bubbles of gas were evolved, due to the decomposition of the ammonium nitrite. The pasty mass of sulphur was treated with alcohol, which extracted the glycerin, subsequently recovered by evaporation. Another portion of the mixture of nitro-glycerin with ammonium sulphide was treated with excess of $PbCO_3$ and a little lead acetate, filtered, and the ammonium nitrite detected in the solution. These qualitative results would be expressed by the equation—



which is similar to that for the action of potassium hydro-sulphide upon gun-cotton.

4. Flowers of sulphur and slaked lime were boiled with water, till a bright orange solution was obtained. This was filtered, and some nitro-glycerin poured into it. The reduction took place much more slowly than in the other cases, and more agitation was required, because the nitro-glycerin became coated with sulphur. In a few minutes, the reduction appearing to be complete, the separated sulphur was filtered off: the filtrate was clear, and the sulphur bore hammering without the slightest indication of nitro-glycerin.

This would be the cheapest method of decomposing nitro-glycerin. Perhaps the calcium sulphide of tank-waste, obtainable from the alkali works, might answer the purpose.

King's College, London, April 11, 1883.

ON A HITHERTO UNOBSERVED RESEMBLANCE BETWEEN CARBONIC ACID AND BISULPHIDE OF CARBON.*

By JOHN TYNDALL, F.R.S.

CHEMISTS are ever on the alert to notice analogies and resemblances in the atomic structure of different bodies. They long ago indicated points of resemblance between bisulphide of carbon and carbonic acid. In the case of the latter we have one atom of carbon united to two of oxygen, and in the case of the former one atom of carbon united to two of sulphur. Attempts have been made to

push the analogy still further by the discovery of a compound of carbon and sulphur analogous to carbonic oxide, but hitherto, I believe, without success. I have now to note a resemblance of some interest to the physicist, and of a more settled character than any hitherto observed.

When, by means of an electric current, a metal is volatilised and subjected to spectrum analysis, the "reversal" of the bright band of the incandescent vapour is commonly observed. This is known to be due to the absorption of the rays emitted by the vapour by the partially cooled envelope of its own substance which surrounds it. The effect is the same in kind as the absorption by cold carbonic acid of the heat emitted by a carbonic oxide flame. For most sources of radiation carbonic acid is one of the most transparent of gases; for the radiation from the hot carbonic acid produced in the carbonic oxide flame it is the most opaque of all.

Again, for all ordinary sources of radiant heat, bisulphide of carbon, both in the liquid and vaporious form, is one of the most diathermanous bodies ever known. I thought it worth while to try whether a body reputed to be analogous to carbonic acid, and so pervious to most kinds of heat, would show any change of deportment when presented to the radiation from hot carbonic acid. Does the analogy between the two substances extend to the vibrating periods of their atoms? If it does, then the bisulphide, like the carbonic acid, will abandon its usually transparent character, and play the part of an opaque body when presented to the radiation from the carbonic oxide flame. This proved to be the case. Of the radiation from hydrogen, a thin layer of bisulphide transmits 90 per cent, absorbing only 10. For the radiation from carbonic acid, the same layer of bisulphide transmits only 25 per cent, 75 per cent being absorbed. For this source of rays, indeed, the bisulphide transcends, as an absorbent, many substances which, for all other sources, far transcend it.

CONTRIBUTIONS TO MINERAL CHEMISTRY.

By A. B. GRIFFITHS, F.C.S.,

Member of the Liverpool Association of Science and Arts,
Medallist in Chemistry and Botany, &c.

(1.) *Rare Elements in Portuguese Iron Ores.*

THESE ores, principally brown and red hæmatites, and ferro-manganiferous ores, were found lying close to the surface in the vicinity of Casa Branca, Odemira, South Portugal. They are all rich minerals, containing between 60 and 70 per cent of iron. A company (The Peninsular Metal Company) was formed about three years ago to work these mines. The works erected were near the banks of a river, which flows into the Atlantic Ocean, so there was every prospect of success, and it was successful for a short time; but ultimately the company collapsed for want of capital. Furnaces were erected, and the fuel used in the reduction was "sepa" or charcoal from the "Herica root," coal not being found in the neighbourhood. The iron yielded was of excellent quality. Several samples of these ores were sent to me some time ago, through the kindness of Mr. D. Griffiths and Mr. J. Ireland, Engineer, of Manchester.

Recently I have examined these ores, and have found traces of several rare elements. In one sample of a ferro-manganiferous ore I found a considerable quantity of tungsten. A sample of brown hæmatite (specific gravity 4.102) showed on analysis traces of titanium. Another sample of brown hæmatite contained traces of titanium and selenium. The specific gravities of these ores varied from 3.742 to 6.210.

(2.) *Analysis of a Copper Ore from Nova Scotia, and Determination of its Formula.*

This ore, a sulphide of copper, occurs in deposits in the north part of Nova Scotia. It is found in nodules, which

* A Paper read before the Royal Society, April 5, 1883.

often contain anthracite bands, and is of a grey colour. On the authority of Dr. Dawson ("Acadian Geology," 2nd edition, 1868), the surrounding formations are of Carboniferous and Silurian ages; and I think it probable that these nodules were formed by the action of water and deposited in these formations, for we find some nodules enclosing bands of anthracite. One of these nodules yielded on analysis the following percentage composition:—

Copper	64.101
Sulphur	25.639
Fe ₂ O ₃ and Al ₂ O ₃	3.891
Sand, &c.	5.790
Lime	0.201
Magnesia	0.137
Manganese	0.221
	<hr/>
	99.980

From the above analysis the formula calculated for this ore is Cu₅S₄, or it may be said to be a mixture of one molecule of cuprous sulphide and three molecules of cupric sulphide, with the formula Cu₂S.(CuS)₃. It will be seen that this is not quite the composition of the natural sulphide of copper known to mineralogists as covellite, although I am given to understand that covellite exists in the same area. The specific gravity of this ore was found to be 4.392.

(3.) Analysis of a Dresden Syenite.

The following is a recent analysis of a syenite from the neighbourhood of Dresden:—

Silica	60.020
Alumina	16.663
Potash.. .. .	6.504
Soda	2.410
Ferrous oxide	7.207
Magnesia	2.509
Lime	3.585
Water	1.100
Phosphoric acid.. .. .	trace
	<hr/>
	99.998

ON THE GALLO-CYANINES.

By HORACE KÆCHLIN.

By allowing an alcoholic solution of nitroso-dimethylaniline hydrochlorate to react in heat upon the tannins, or upon gallic acid, there are obtained violet colouring-matters, verging more or less upon a blue according to the nature of the tannin employed. These colouring-matters, which the author names gallo-cyanines, are manufactured by MM. Durand and Huguenin, their chemist (M. Charles Mayer) having succeeded in rendering their preparation practicable.

The gallo-cyanine obtained from gallic acid is sold as "Violet Solide D. H.," in the form of a paste of minute crystals of a metallic lustre, and containing 10 per cent of the dry product.

The author gives a tabular view of the reactions of three varieties of gallo-cyanine—that from gallic acid, that from catechine, and that from morine or morintannic acid. The first-mentioned gives chiefly blue colours; the second, shades more inclining to a red; and the third, greens.

The best solvents for gallic gallo-cyanine, for its industrial applications, are ammonia, soda, and the acid sulphites. Caustic soda at 38° (Baumé?), in the proportion of 1-30th by volume; and sodium bisulphite at 41°, in the same proportion. If this proportion of bisulphite

is exceeded the gallo-cyanine is decomposed, being transformed into an orange colouring-matter, and a substance which remains undissolved and which falls off in a powder from the dyed or printed goods.

The action of the bisulphite is slow, requiring twenty-four hours of contact. At the end of this time the solution is complete, even with 1-60th.

Gallic gallo-cyanine dyes woollens and silks a violet-blue; for woollens a little potassium chlorate should be used in the dye-beck.

The author has experimented with different metallic oxides for fixing this colour upon cotton in dyeing and printing, and he finds that, like alizarine, it requires double mordants. In printing, chrome alone gives shades which bear soaping well. In dyeing, tin, chrome, cobalt, or nickel may be used; with the other oxides the violet does not stand soaping at a boil.

The following colours give a good result in printing:—

Starch	4 kilos.
Water	2 litres.
Tragacanth water	16 "
Violet D. H., which has been disaggregated by maceration for twenty-four hours with 1-32nd part sodium bisulphite	18 "
Oil	2 "

Calcium acetate, 18° 1½ litre.

Acetic acid 6 litres.

Chromium acetate, at 16° 9 "

Or—

Starch	6 kilos.
Calcined starch	6 "
Water	10 litres.
Violet D. H.	30 "
Acetic acid	5 "

Chromium acetate, 20° 10 "

Magnesium acetate, 30° per litre of colour 4 "

Potassium sulpho-cyanide 25 grms.

Light or diluted colours are thickened with gum. After printing, the pieces are steamed for two or three hours, washed, and soaped.

For dyeing cottons the author prepares them by steeping in—

Water	10 litres.
Tin crystals	1000 grms.
Stannic chloride, hydrated, 55°	¼ litre.

Washing the next day, and dyeing in violet which has been prepared with bisulphite. The force of the mordant may be increased by a passage through hot chromium acetate, half a litre per piece.

The process of MM. Blondel and Scheurer may also be used. They print—

Potassium dichromate	800 grms.
Water	4 litres.
Caustic soda, 38°	600 grms.
Sodium hyposulphite	800 "
Water	2 litres.
Thick tragacanth water	2 "
Magnesium acetate, 30°	½ litre.

The last ingredient is indispensable. Steam for two hours, wash, and dye in the violet D. H.

The following process succeeds well, printing on—

Chrome-alum	2 kilos.
Dissolved in chromium acetate, 16°	1 litre.
Tragacanth	1 "
Stannic chloride, hydrous, 60°	½ "
Magnesium sulphate	500 grms.

For pale shades this mordant is reduced with tragacanth. It is fixed by a passage through hot sodium carbonate, at 500 grms. per litre, and then duned in lime-water at 80°, with $\frac{1}{2}$ gm. lime per litre.

When dyeing in gallo-cyanine it is always prudent to ascertain that the flots have not an alkaline reaction, and that they slightly redden litmus-paper.

Self-coloured goods may be worked in an ammoniacal solution of the violet, and then in chromium acetate.

These colours resist light and various reagents better than do alizarine violets. Neither concentrated hydrochloric acid nor caustic soda at 38° B. changes the tone of the violets fixed with chrome. The solidity of the violets offers curious variations according to the preparation of the cloth. If it is prepared with stannate the shades are faster as against chlorine, but they resist light better upon unprepared cloth. The violet obtained with gallic gallo-cyanine is not sufficiently decomposed by chromic acid to produce upon this colour the discharges which are obtained upon vat-blue ground. Yellow or maize discharges may, however, be produced by printing the violet over a chrome-orange design which has been saturated with bichromate, and then, after cleansing, taking the pieces through lukewarm oxalic acid at 25 grms. per litre.

By adding either berry-liquor or alizarine to the colour,

THE PLATINUM-WATER PYROMETER.

By J. C. HOADLEY.

THE following description of the apparatus used for the determination of high temperatures, up nearly to the melting-point of platinum, is offered in answer to several inquiries on the subject.

The object to be attained is a convenient and reasonably accurate application of the method of mixtures to the determination of temperatures above the range of mercurial thermometers, say 500° F., up to any point not above the melting-point of the most refractory metal available for the purpose, platinum.

A first requisite is a cup or vessel of convenient form, capable of holding a suitable quantity of water, say about two pounds avordupois. Berthelot decidedly prefers a simple can of platinum, very thin, with a light cover of the same metal, to be fastened on by a bayonet hitch. For strictly laboratory work, this may be the best form; but for the hasty manipulation and rough usage of practical boiler testing something more robust, but, if possible, equally sensitive, is required. The vessel I have used is represented in section in the accompanying cut, Fig. 1.

The inner cell, or true containing vessel, is 4.25 inches in diameter, and of the same height on the side, with a

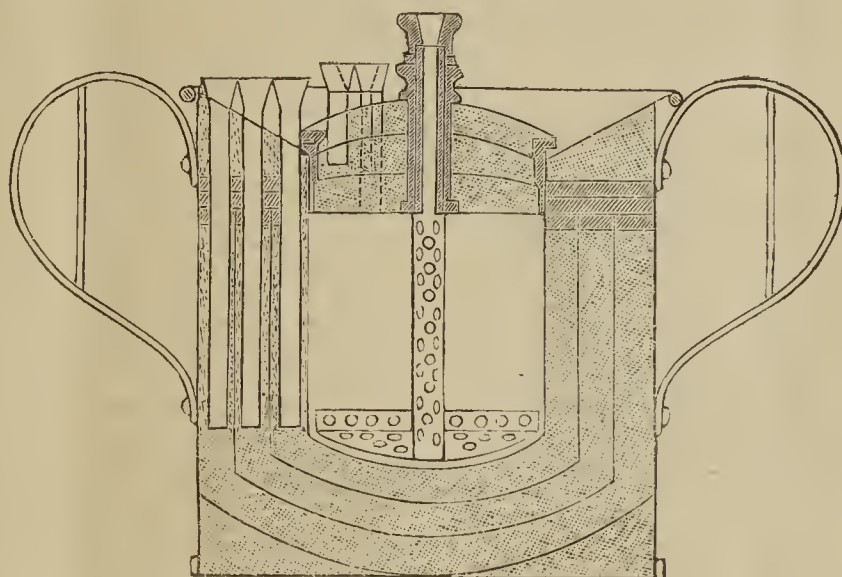


FIG. 1

or to the dye-beck, olives and "loutres" are produced. Alizarine, in the proportion of 1-30th, considerably enhances the strength of the colour, without sensibly affecting its tone.

Gallic gallo-cyanine dyes violets with aluminous mordants, and blacks with those of iron. These shades do not bear soap, and become white in a boiling soap-bath. In consequence of this inability to resist soap it is possible to print simultaneously alizarine steam reds and a mordant, to dye in violet, and to soap at a boil. The reds which have taken up a certain quantity of violet, and have become garnets, are thus restored to their primitive shade.

Catechine gallo-cyanine gives, in printing and dyeing, redder shades than gallic gallo-cyanine. It is fixed in the same manner, and dyes violets with alumina and iron, which bear soaping at a boil.

Morine or morintannic gallo-cyanine is green; it is fixed in printing with chromium acetate. It dyes olives with mordants of chrome, tin, alumina, and iron. These olives are exceedingly fast against soap.

Ammonium hydrosulphite easily dissolves and reduces it, thus forming a vat in which goods may be dyed by immersion and subsequent oxidation in the air, precisely as with indigo. In dyeing wool the solution must be heated.—*Moniteur Scientifique*.

bottom in the form of a spherical segment, of 4.25 inches radius. It is formed of sheet brass 0.01 inch thick, nickel-plated and polished outside and inside. The outer case is 8 inches diameter and 8.5 inches deep, of 16-ounce copper, nickel-plated and polished inside, but plain outside. There are two handles on opposite sides, for convenience of rapid manipulation. The top, of the same copper as the sides and bottom, is depressed conically, like a hopper, and wired at its outer edge, forming a lip all around for pouring out of. The central cell is connected with the outer case only by three rings of hard rubber (vulcanite), each 0.25 inch thick, the middle ring completely insulating the cell from its continuation upward, and from the outer case. A narrow flange is turned outward at the upper edge of the cell, and a similar flange is also turned outward at the lower edge of the cylindrical continuation of the walls of the cell upward. Between these two flanges, the middle ring of hard rubber is interposed, and the two parts, the cell and its upward continuation, are clamped together by the upper and lower rings of hard rubber, which embrace the flanges and are held together by screws. The joints between the flanges and the middle ring of hard rubber, which might otherwise leak a little, are made tight with asphaltum varnish.

Fig. 1. shows two partitions, dividing the space between the cell and the case into three compartments, and a con-

cave false bottom. The cover is also seen to be divided into three compartments, by two partitions, and each compartment of the vessel and of its cover is provided with a small tube for inserting a thermometer. This construction was adopted in the first instruments made, for the purpose of observing the rate of heat transmission through the successive compartments, but these parts are without importance with respect to the practical use of the instrument, and may as well be omitted, as they considerably increase the cost, being nickel-plated and polished on both sides. The top and bottom plates of the cover are of 0.01 inch brass, nickel-plated and polished on both sides, both convex outward, the bottom plate but slightly, the top plate to 4.25 inches radius. A ring of hard rubber connects, yet separates and insulates these plates, and they are bound together with the ring into a firm structure by a tube of hard rubber, having a shoulder and knob at the top, and at the lower end a screw-thread engaging with a thin nut soldered to the upper-side of the bottom plate. When the cover is in place, its lower plate is even with the top of the cell; and the contained water, which nearly fills the cell, is surrounded by polished, nickel-plated, brass plates 0.01 inch thick, insulated from other metal by interposed hard rubber. The spaces between the cell and case (a single space if the partitions are omitted), the space above the hard rubber rings and the space or spaces in the cover are all filled with eider-down, which costs 1.00 dol. per ounce avordupois, but a few ounces are sufficient. Soft, fine shavings, or turnings of hard rubber are said to be excellent as a substitute for eider-down. Heat cannot be confined by any known method. Its transmission can be in some degree retarded, and in a greater degree, perhaps, regulated. Some heat will be promptly absorbed by the sides, bottom, and cover of the cell, and by the agitator; but this does no harm, as its quantity can be accurately ascertained and allowed for. Some will be gradually transmitted to the eider-down, filling the spaces, and through this to the outer casing; but this can be reduced to a minimum by rapid and skilful manipulation, and its quantity, under normal conditions, can be ascertained approximately, so as not to introduce large errors. But varying external influences, such as currents of air, caused by opening doors, or by persons passing along near the apparatus during the progress of an experiment, which would introduce disturbing irregularities, can best be guarded against by such spaces as I have described, filled with the poorest heat conductor and the lightest *solid* substance attainable. Air, although a poor heat-conductor, and extremely light, is diathermous, and offers no obstruction to the escape of radiant heat.

The agitator is an important part of the apparatus. Its object, in this instrument, is two-fold. *First*, it serves to produce a uniform temperature throughout the body of water in the instrument; and *secondly*, it answers as a support to the heat-carrier of platinum or other metal, often intensely hot, which would injure or destroy the delicate metal of the bottom if allowed to fall on it. For this second purpose, no spiral revolving agitator, such as that commended by Berthelot, would suffice. The best form is such as I have shown in Fig. 1. A concave disc of sheet brass, made to conform to the shape of the bottom of the cell, with a narrow rim turned up all around, of about 0.02 inch thickness, is liberally perforated with holes to lighten it, and to give free passage to water. The concave form causes the streams of water, produced by slightly raising and lowering the agitator, to take a radial direction downward or upward, so as to cross each other and promote rapid mixing. By a slight modification small vanes might be turned outward from the surface of the metal, which would produce mixing currents if the agitator were given a slight reciprocatory revolving motion, thus avoiding the alternate withdrawal and re-immersion of any part of the stem so strongly deprecated by Berthelot; but for several reasons I think an up and down motion of the agitator desirable in this instrument. The

platinum heat-carrier, sometimes at a temperature of 2500° to 2800° F., is thereby brought into more rapid and forcible contact with the water, steam or water in the spherical condition is washed away from its surface, and by cooling it more rapidly, the duration of the observation is lessened, and errors due to transmission of heat through the walls of the instrument are diminished. The upper part of the agitator stem is of hard rubber, and the brass portion, which terminates at the under side of the cover when the agitator is in its lowest position, suspended by the shoulder at the upper end, need never be lifted for the purpose of mixing out of the hard rubber tube at the cover, so that loss of heat from this cause must be very slight. The brass tube is very freely perforated with holes to admit water, streaming radially through the holes in the agitator, to contact with the thermometer. The hole in the stem at the top is flared, to receive a cork, through which the thermometer is to be passed. The bulb of the thermometer should be elongated, and very slightly smaller in diameter than the stem. After passing it through the cork, a very slight band—a mere thread—of elastic rubber should be put around the bulb, near its lower end, or a thin, narrow shaving of cork may be wound around and tied on, to keep it from contact with the brass tube, for safety; and a little tuft of wool, curled hair, or hard rubber shavings should be put in the bottom of the brass tube to avoid accidents. For the same purpose, a light, but sufficient fender of brass wire, say 0.03 inch diameter, might be judiciously placed around the brass tube at a little distance, to protect it and the thermometer inside of it from shocks from the platinum ball when hastily thrown in, as it must always be. I have had delicate and costly thermometers broken for want of such a fender. Thermometers cannot be too nice for this work. For accurate work at moderate temperatures, they should be about 14 inches long, having a "safe" bulb at the upper end, with a range of 20° F.—32° to 52°—in a length of 10 inches, giving half an inch to a degree F., and carefully graduated to tenths of a degree, so that they can be read to hundredths, corresponding to single degrees of the heat-carrier in the normal use of the instrument.

For the determination of the highest temperatures, up closely to 2900° F., it will be convenient to have thermometers of greater range, say 32° to 82° F., 50° in a length of 12.5 inches, or a quarter of an inch to a degree F., also graduated to tenths, or at the least, to fifths of a degree. Such thermometers will be about 17 inches long.

It is very satisfactory to have *two* instruments and a good outfit of thermometers and heat-carriers, in order to take duplicate observations for mutual verification and detection of errors.

Heat-Carriers.

For these platinum is greatly to be preferred to any other known substance. Its rather high cost is the only objection to its use. Its heat capacity is low, by weight, but its specific gravity is great, and sufficient capacity can be obtained in moderate bulk, while its high conductivity tends to shorten the duration of each experiment or observation. A convenient outfit for each instrument consists of three balls, hammered to a spherical form, one 1.1385 inches diameter, weighing 4800 grains, = 0.6 pound avordupois; one 0.9945 inch diameter, weighing 2800 grains, = 0.4 pound; and one 0.7894 inch diameter, weighing 1400 grains, = 0.2 pound.

These can be obtained at 1 $\frac{3}{4}$ cents per grain, and will cost, respectively, 70.00 dols., 46.67 dols., and 23.33 dols., and collectively, 140.00 dols. At the assumed specific heat of Pt = 0.0333, the heat capacity of the respective balls will be $\frac{1}{100}$, $\frac{1}{150}$, and $\frac{1}{300}$ of two pounds of cold water, and the two smaller balls used together will be equal to the larger one. Corrections for varying specific heat of platinum may be conveniently made by the tables given in a previous article.* Corrections for varying specific

* *Journal of the Franklin Institute* for August, 1882, pp. 97, 98, and errata in *Journal of the Franklin Institute* for September, p. 172.

Temperatures, Fahrenheit, and Corresponding Number of British Thermal Units Contained in Water from Zero Fahrenheit.

Deg.	B.T.U.	Deg.	B.T.U.
32	32'000	82	82'039
33	33'000	83	83'041
34	34'000	84	84'043
35	35'000	85	85'045
36	36'000	86	86'047
37	37'000	87	87'049
38	38'000	88	88'051
39	39'001	89	89'053
40	40'001	90	90'055
41	41'001	91	91'057
42	42'001	92	92'059
43	43'001	93	93'061
44	44'002	94	94'063
45	45'002	95	95'065
46	46'002	96	96'068
47	47'002	97	97'071
48	48'003	98	98'074
49	49'003	99	99'077
50	50'003	100	100'080
51	51'004	101	101'083
52	52'004	102	102'086
53	53'005	103	103'089
54	54'005	104	104'092
55	55'006	105	105'095
56	56'006	106	106'098
57	57'007	107	107'101
58	58'007	108	108'104
59	59'008	109	109'107
60	60'009	110	110'110
61	61'010	111	111'113
62	62'011	112	112'117
63	63'012	113	113'121
64	64'013	114	114'125
65	65'014	115	115'129
66	66'015	116	116'133
67	67'016	117	117'137
68	68'018	118	118'141
69	69'019	119	119'145
70	70'020	120	120'149
71	71'021	121	121'153
72	72'023	122	122'157
73	73'024	123	123'161
74	74'036	124	124'165
75	75'027	125	125'169
76	76'029	126	126'173
77	77'030	127	127'177
78	78'032	128	128'182
79	79'034	129	129'187
80	80'036	130	130'192
81	81'037	131	131'197

heat of water are less important, but may be made by the above Table.

A composite heat-carrier, of iron covered with platinum, answers well for temperatures up to about 1500° F. A ball of wrought-iron 0.88 inch diameter will weigh 700 grains, and a capsule of platinum spun over it 0.048 inch thick, making the outside diameter 0.976 inch, will also weigh 700 grains. Upon the assumption of 0.0333 for the specific heat of Pt and 0.1666 for that of Fe, the composite ball will have a heat capacity equal to that of 4200 grains of Pt, and equal to 0.01 of that of two pounds of cold water. A patch, about 0.35 inch diameter, has to be put in to close the orifice where the Pt capsule is spun together, and a slight stain will show itself at the joint around this patch, from oxidation of the iron, but the latter will be pretty effectually protected. Difference of expansion, which will not exceed 0.007 inch in diameter, will not endanger the capsule of Pt. The interruption of conductivity at the surface contact of the two metals

makes the process of heating and cooling a little slower, but not noticeably so.

Such composite balls can be obtained for 20 dols. each, 50 dols. less than the cost of an equivalent ball of solid platinum, which is preferable in all but cost. Iron balls could be used for a few crude determinations. Cast-iron varies too much in composition, and wrought-iron oxidises rapidly. While the oxide adheres it gains in weight, and when scales fall off it loses; and the specific heat of the oxide differs from that of metallic iron. Whatever metal is used, care must be taken to apply the appropriate tabular correction for Pt, Fe, or Pt, and Fe.

Manipulation.

Small graphite crucibles with covers, as shown in section in Fig. 2, serve to guard against losing the ball, to handle it by when hot, and to protect it against loss of heat during transmission from the fire to the pyrometer. To guard against overturning the crucibles, moulded fire-brick should be provided to receive them,—two crucibles being put into one brick, in the same exposure, whenever great accuracy is desired, each serving as a check on the other, and their mean being likely to be more nearly correct than either one if they differ. The fire-brick cover is occasionally useful to retard cooling if, by reason of local obstructions, some little delay is unavoidable in transferring the balls from the fire to the water of the pyrometer. With convenient arrangements this may be done

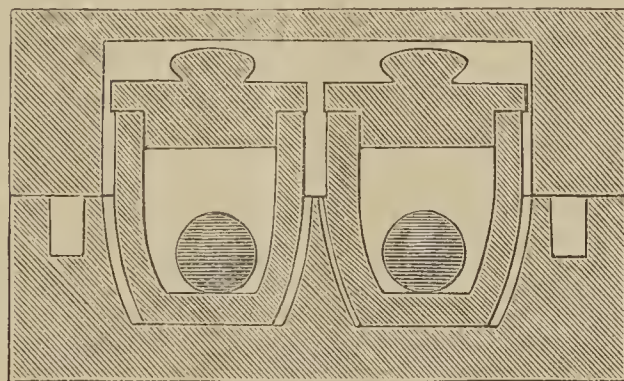


FIG. 2

in three seconds. After observing the temperature of the water, make ready for the immersion of the heat-carrier by raising the agitator until a space of only about 1.5 inch is left between its rim and the cover. An instant before putting in the heat-carrier—"pouring" it in from the crucible—lift the cover and agitator both together, so that the rim of the latter is level with the sloping top of the instrument. The agitator then receives the hot ball without shock, and no harm is done. If the ball goes below the agitator it is likely to injure the bottom of the cup. If, on taking the temperature of the water before the immersion of the heat-carrier, any change is observed, either rising or falling, the direction and rate of such change, and the exact interval of time between the last recorded observation and the immersion should be noted, in order to determine the exact temperature of the water at the instant of immersion. The temperature of the water will continue to rise as long as the heat-carrier gives out heat faster than the cell loses it. The rise will grow gradually slower until it ceases, and the maximum can be very accurately determined. Examples of the mode of using the tables, and of determining the true temperature of the heat-carrier at the instant of immersion from the observations with the instrument, are given in the table on pages 170 and 171 of the *Journal of the Franklin Institute* for September. A method of using the tables by which a closer approximation to the true temperature may be reached will be pointed out in a subsequent article.

Determination of the Calorific Capacity of the Metals of the Pyrometer, in terms of Water, i.e., in British Thermal Units.

First. Weigh the cup, or cell, the lower plate of the cover and the metallic portion of the agitator, and compute their heat-capacity by the specific heat of the respective metals. Compute also the heat-capacity of the thermometer; or, if it be long, of so much of it as is found to share nearly the temperature of the immersed portion. The result will be a minimum,—indeed, in so small a vessel the inevitable loss by conduction and radiation will amount to more than one-third as much as the simple heat-capacity of the metals.* The total must be ascertained by an application of the method of mixture. Ascertain the temperature of the interior of the instrument simply; pour in quickly but carefully a known quantity of water, say about two pounds, of known temperature, say about 100° F., and ascertain the temperature as soon after pouring as mixing can be properly performed. But a correction is necessary for loss of heat in the act of pouring. To ascertain the amount of this correction prepare a bath of tepid water, and bring all parts of the instrument—outside, inside, and interior portions, together with the vessel to pour from—exactly to one common, carefully ascertained temperature. Now take two pounds of the water and pour it into the cell in the same manner as before. Exposure of so thin a stream on two surfaces to the air of the room will produce a certain degree of refrigeration in the water, which is supposed to be warmer than the air, say at about 160° F. This effect will be due to conduction, by contact with the air, to radiation, and to evaporation; and by so much the refrigeration observed in mixing is to be diminished.

Four experiments, carefully conducted, gave the following results:—

Loss of temperature by pouring at 170°, 0.81°, 0.86°, 1.00°, and 1.07° F.; mean, 0.935° F.

The following are values of the calorific capacity of my pyrometers, that is, of those parts of each which share directly the temperature of the enclosed water, including the thermometer to be used with the instrument, and the heat communicated to the eider-down and otherwise lost during an observation, expressed in decimals of a British thermal unit, or in decimals of a pound of cold water:—

0.1048, 0.1052, 0.1077, 0.1008, 0.1028, and 0.01104.	
Mean.. .. .	0.1053 = 0 lb. 1 oz. 11 drms.
Add water .. .	1.8947 = 1 „ 14 „ 5 „
	<hr/>
	2.0000 = 2 „ 0 „ 0 „

This was the value used. The instrument, being put on delicate coin scales and counterbalanced, weights equal to 1.8947 lbs. avordupois = 1 lb. 14 ozs. 5 drms. were added to the counterbalancing weights, and cold water was poured in until the scales again balanced.

The pyrometer with its contained water was then just equal in heat-capacity, while the temperature was not above 38° F. to two pounds of cold water. The two instruments were sensibly alike, but were numbered No. 1 and No. 2, and at each observation the one used was noted.

The process of preparation and testing appears long and tedious, and is indeed somewhat so; but the instruments once well made are durable, convenient in use, and with care reasonably accurate.

Compared with mercurial thermometers between 212° and 600° F., I believe them to be much more accurate, although less convenient.

For a range of temperatures from 212° to 900° F., they are certainly more trustworthy than anything save an air thermometer of suitable construction; and for all temperatures from 800° or 900° F. up nearly to the melting-

point of platinum they are without a rival, so far as I know.

For some situations the ball can best be inserted in the fire or other situation where an observation is desired, and withdrawn for immersion by means of long, slender tongs, with jaws resembling bullet-moulds.

A word about the melting-point of platinum. My balls certainly began to melt below 2950° F., but I am by no means sure that they do not contain any silver, although their specific gravity gives assurance that they are at least nearly pure.—*Journal of the Franklin Institute.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 5, 1883.

Dr. W. H. PERKIN, F.R.S., President in the Chair.

It was announced that a ballot for the election of Fellows would take place at the next meeting of the Society (April 19). The following certificates were read for the first time:—H. R. Mill, J. E. Richardson, A. H. Samuel R. Williams.

Mr. L. T. WRIGHT then read a paper "*On the Estimation of Hydrogen Sulphide and Carbonic Anhydride in Coal-gas.*" In the analysis of crude coal-gas by absorptiometric methods—as in Bunsen's, &c.—it is usual to term that portion of the gas which is absorbed by manganic peroxide, ferric oxide, &c., hydrogen sulphide; whilst that portion which is absorbed by caustic potash, and not by manganic peroxide, is usually designated carbonic anhydride. The author first gives some results obtained, by absorption with a bullet of manganese peroxide and with KHO solution, in a Frankland and Ward apparatus: higher results were always obtained when the gases were absorbed successively than when they were absorbed simultaneously by using a solution of KHO. This difference between the results was considerably diminished by submitting the manganese bullet to a current of clean coal-gas before using it for absorption. The author prefers the following method:—The crude coal-gas, dried and freed from ammonia by passing through phosphoric acid, is passed through two weighed U-tubes, the first charged with roughly powdered cupric phosphate in one leg and calcium chloride in the other, the second containing soda-lime (slightly moistened by exposure to the air for about eighteen hours) and calcium chloride. The increase of weight in the first gives the sulphuretted hydrogen, in the second, the carbonic anhydride. The copper phosphate is prepared thus:—2 lbs. of ordinary phosphate of soda are dissolved in 1 gallon of water, and 2½ of cupric sulphate in 1½ gallons of water. The two solutions are vigorously stirred together, the precipitate washed by decantation, and dried at 100° C. Cupric phosphate thus prepared absorbs hydrogen sulphide very perfectly. Before using the absorption-tubes, 3 cubic feet of clean dry coal-gas are passed through to "saturate" the reagents. The gas during the absorption should be passed at the rate of quarter to half a cubic foot per hour. The total quantity must vary with the impurity in the gas. The sum of the hydrogen sulphide and carbonic anhydride thus estimated is always greater than the number obtained by absorbing these gases simultaneously in one U-tube charged with soda-lime. A six inch U-tube charged with cupric phosphate will absorb 20 grains of hydrogen sulphide. A similar sized U-tube charged with soda-lime will absorb perfectly 18 grains of carbonic anhydride.

Dr. ARMSTRONG suggested that some acetylen might be absorbed by the cupric phosphate.

* In our case the heat-capacity, thermometer included, was 0.0757; total, 0.1053; radiation, &c., 0.0296. Respectively, 71.9 per cent, and 28.1 per cent of the total.

The PRESIDENT asked if bisulphide of carbon vapour was absorbed by soda-lime.

Mr. WRIGHT said that he did not think that the gain of weight was due to absorption of acetylen, and in answer to the President said that bisulphide of carbon was not absorbed by ordinary soda-lime from gas previously freed from hydrogen sulphide.

The SECRETARY then read a paper entitled "*Contribution to the Chemistry of the Cerite Metals*," by B. BRAUNER. In the first part of the paper the author gives an account of a most careful determination of the atomic weight of didymium. The numbers obtained by chemists differ widely from each other, from 142 to 147.39. The author finds that the so-called pure didymium can be split up into heterogeneous constituents. By an elaborate process of purification a sulphate was obtained, which was proved by fractional precipitation with ammonia and with sulphate of potassium to be homogeneous. From this preparation the atomic weight of didymium was found to be 145.4. In a previous paper the author obtained the number 146.58, whilst Clève gave the atomic weight as 147.2. Such discrepancies seemed to indicate the presence of some metal of higher atomic weight and of a less basic nature. This metal the author eventually succeeded in isolating: its formiate is difficultly soluble, and by its absorption-spectrum it was identified with samarium. The author has calculated its atomic weight to be 150. The effect of the presence of samarium on the absorption-spectrum of didymium is carefully studied. The paper concludes with an investigation as to whether cerite contains earths of the yttria group as well as those of the cerium group. By taking advantage of the solubility of the formiates of the yttria group, the author separated out a fraction with atomic weight 114.5, whose spark spectrum showed the presence of yttria, whilst holmia, thullia, and erbia were recognised by their absorption-bands, and the presence of terbia also was suspected.

A communication entitled "*Some Compounds of Antimony and Bismuth containing Two Halogens*," by R. W. ATKINSON, was then read by the SECRETARY. Amongst the so called double salts one of the best characterised is that produced from antimonious chloride and potassic chloride. The author has prepared the compounds obtained by combining antimonious chloride with potassium bromide and antimonious bromide with potassium chloride. On the theory of a molecular combination the first compound should be $\text{SbCl}_3 + 3\text{KBr}$, the second $\text{SbBr}_3 + 3\text{KCl}$. In both cases the author finds that the compound $\text{Sb}_2\text{Cl}_6\text{Br}_6\text{K}_6 + 3\text{H}_2\text{O}$ is formed. The identity of the two compounds was proved by identity in colour, crystalline form, formula, and chemical behaviour. The action of heat upon the crystals is of considerable interest. At 100° the lemon yellow substance darkens, and between 200° and 300° white antimonious fumes escape, leaving a white mass behind, which contains chlorine and bromine in equal atomic proportions. Attempts to prepare a similar bismuth compound were unsuccessful, but a yellow crystalline salt, $\text{Bi}_2\text{Cl}_6\text{Br}_4\text{K}_4 + 3\text{H}_2\text{O}$, was obtained.

Prof. McLEOD said that it would be of great interest to ascertain the composition of the antimonious fumes given off when the substance was heated.

The Society then adjourned to April 19th.

Determination of Gum in Liquorice Juice.—Madson precipitates the aqueous extract with alcohol at 0.83 sp. gr., and washes with alcohol till all sugar is removed. The precipitate is dissolved in a minimum of water, mixed with copper sulphate solution, and precipitated with soda-lye in excess. The precipitate is collected upon a filter, washed with soda solution till the washings run through colourless, dissolved on the filter in dilute hydrochloric acid, the filter rinsed with water, and the arabin thrown down from the solution by the addition of alcohol of sp. gr. 0.83 .—*Zeit. für Anal. Chem.*

NOTICES OF BOOKS.

City and Guilds of London Institute for the Advancement of Technical Education. Report to the Governors, March 14, 1883. Gresham College.

WE have here a somewhat voluminous report showing the action and progress of the Institute for the past season. The results are upon the whole satisfactory, and warrant us in entertaining good hopes for the future, especially if certain of the besetting faults of English educational establishments can be avoided.

The Finsbury Technical College is now in fair working order, and in it more than 500 students are already receiving instruction. The South London School has gone on satisfactorily, and we are told that "the number of candidates for the Technological Examinations has steadily increased." Whilst accepting this fact as evidence that the Institute is receiving wider recognition, we cannot refrain from pointing out that a man may possibly acquire a very full and exact verbal knowledge of the principles of an industrial art and still be practically ignorant.

It is satisfactory to learn that a precedent has been established by the late Master of the Rolls for converting apprenticeship-trusts into scholarships tenable at the Technical Colleges of the Institute. The funds of the Institute have been increased, but it is added not to the extent hoped for. The Grocers' Company have continued their subscription of £2000; the Drapers' Company have increased their subscription from £4000 to £4500; the Fishmongers' Company subscribe £2000; the Goldsmiths' £4000; the Clothworkers' £3000; the Mercers' £2000; and a like sum is subscribed by the Corporation of London. Altogether 29 of the City Companies may rank as contributors. Large, however, as these sums are, it is evident that very much larger funds will have to be provided. The Institute has in hand a total of £85,450 to meet present or prospective liabilities of £89,150. In what manner the necessary resources are to be provided it does not clearly appear. It seems almost to be regretted that the money now spent in forcing elementary education upon those who do not desire it had been applied in this direction.

Particular attention is due to a speech delivered by Dr. Siemens, F.R.S., at a meeting held on Dec. 14th last, for the delivery of prizes and certificates. The speaker gave an interesting sketch of the old Guild system, as it existed in Germany down to 1869. It is well known that in modern England the mere fact of having served an apprenticeship is sufficient, in certain trades at least, to place the merest bungler or idler on a level with the clever and competent artisan, whilst, on the other hand, no amount of skill and practical knowledge is recognised, except the form of apprenticeship has been gone through. This was not the case in Germany. Apprenticeship was, indeed, universal, but at its expiry the young man had to undergo an examination, not verbal but practical. He had to produce his "Gessellenstück," literally journeyman's piece of work, which was duly examined by the masters of his trade in the town. If it was found satisfactory he ranked as journeyman, and for the next four years he was expected to travel, obtaining employment under different masters in the towns which he visited, and thus perfecting himself and becoming familiar with different styles and methods of work. At the end of this time he went back to his native city, and if desirous of establishing himself as a master he had to produce his "Meister Stück," or master-piece. This specimen was examined by a Committee of his Guild, and if approved of, duly exhibited and retained in a local museum. These master-pieces were often real works of art. Dr. Siemens makes mention of the old Trade Museum of Nuremberg, where many splendid specimens of the skill of the blacksmith, the weaver, and the clock-maker, &c., are still preserved. These old Guilds,

we are told, did not seek to fix the rate of wages or the hours of work. Their great object was to exclude from every trade the incompetent and the dishonest. Any master who sold fraudulent articles was, on conviction, expelled from the Guild. Much, of course, of these old regulations is incompatible with the modern organisation of business, but the general principle of a practical examination as a necessary preliminary for every person engaging in any art or manufacture is undoubtedly sound.

Dr. Siemens most justly remarks that "It is not sufficient for after life to be competent to perform the routine work of a craft or calling. Unless you comprehend the scientific principles underlying that calling you may be left high and dry any day, in consequence of an invention which may entirely change the mode of performing the operation upon which you have been engaged."

Of this an instance occurred in the stuff-dyeing trade about 30 to 35 years ago. Up to that time the stuffs dyed in the piece had consisted of pure worsted. When they were first woven with cotton warps, not a few dyers were thrown into a state of perplexity. They knew all the manipulations of their trade, they could dye a piece to the shade required, and they possessed a good stock of receipts for the colours in demand, but they had no knowledge of general principles, and when called upon to encounter cotton warps they felt the ground taken from under their feet.

We note with pleasure that a regular course of study is proposed for each branch of industry with which the Institute concerns itself. The Council quite agree with us in complaining of the "unsystematic and desultory instruction which students too frequently receive in ordinary Science classes."

Reference is made in the report to the Royal Commissioners on Technical Education, who have "continued their inquiry into foreign schools, and whose report may be expected before the close of the present Parliamentary Session. But unless we are completely at fault, investigations of a similar nature have already been made, and reports have already been published. We know that in the facilities for technical education we are inferior, *e.g.*, to Germany and Switzerland, and we know why. Surely, then, it is time for action, instead of inquiry. Commissions are sometimes a convenient method of postponing what public opinion demands.

We were particularly struck with the subjoined passage: "Nowhere in Europe does there exist a system of evening Technical Instruction similar to that which is carried on jointly by the Science and Art Department and the City and Guilds of London Institute through their system of annual examinations and *payment on results*." The words we have italicised denote one of the weak points of English education. We may estimate the "results" of a physician by the cases he cures, of a lawyer by the verdicts he gains, or of a general by the battles he wins. But for the "results" of a teacher we have merely the illusory standard of examinations. Conscientious teachers, of whom we have no lack, complain that they are hampered with a two-fold and a heterogeneous task; on the one hand they wish to give their pupils a thorough knowledge of the subject taught, but on the other they must get them to "pass,"—since on that point payment depends. Unconscientious teachers have an easier task: they simply prepare the pupils for the examinations. The only way to judge of the efficiency of *e.g.* a teacher of chemistry would be to sum up in after years the number of discoveries and inventions effected by his pupils.

If the Institute could be induced to discard this system of payment by sham results it would effect much more for the industrial future of the kingdom than it can otherwise hope to effect.

Determination of Urea by Means of Oxalic Acid.

—E. Brücke.—The alcoholic solution of the urea is mixed with a concentrated ethereal solution of oxalic acid.—*Zeit. fur Anal. Chem.*

CORRESPONDENCE.

CHOKE-DAMP.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xlvii., p. 159), Dr. Wallace states that *choke-damp* is a "name which in our language is applied exclusively to carbonic acid gas." There can be no doubt that there are many people whose notions of combustion are of the crudest, who talk as if the air were nothing but oxygen, and who regard the miners' choke-damp as nothing but carbonic acid. But surely Dr. Wallace will admit that some people know better; and that they, together with the miners themselves, who are free from the little knowledge that is dangerous, apply the word choke-damp to the mixture of gases that remains in a mine after an explosion—I am, &c.,

H. CHAPMAN JONES.

April 7, 1883.

ACETATE OF LIME.

To the Editor of the Chemical News.

SIR,—I have made a series of experiments with regard to finding a reliable method of estimating the acetic acid in commercial acetate of lime, and find the following gives the best results; the sample is finely ground and about 6 grms. weighed into a half-litre flask, dissolved in water, and diluted to the containing mark. 100 c.c. of this solution are distilled with 70 grms. of strong phosphoric acid nearly to dryness, and 50 c.c. of water are added to the residue in the retort and distilled till the distillate gives no precipitate with nitrate of silver, titrate the distillates with standard caustic soda, evaporate to dryness in a platinum dish, and ignite the residue before the blowpipe, which converts the phosphate of soda (formed by a little phosphoric acid carried over in the distillation) into the insoluble pyrophosphate and the acetate of soda into NaHO; dissolve in water, and titrate with standard H₂SO₄, which gives the amount of soda combined with the acetic acid in the original sample. In a number of samples so analysed they were found to vary hardly anything.—I am, &c.,

C. H. SLAYTOR, F.C.S., London and Berlin.

Regent Square, Doncaster,

April 3, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 12, March 19, 1883.

Observations on Blue Milk.—J. Reiset.—The author mentions that, contrary to the statements of the textbooks, freshly-drawn milk has not an alkaline reaction. It reddens blue litmus paper distinctly, the red colour remaining when the paper is dry. On the other hand, it turns red litmus a pale blue, which disappears on the desiccation of the paper. Chevreul alone admits that milk, as it issues from the udder, distinctly reddens litmus.

New Equations relating to the Transport of Power.—Marcel Deprez.—A mathematical paper, not susceptible of useful abstraction.

The Transportation of Power by Batteries of Electric Apparatus.—James Moser.—For the transportation of power on a large scale, the author proposes

to construct enormous accumulators with very large surfaces, and of a very high tension, some at the original source of the power, and others at the place where it is to be employed.

Influence of Tempering on the Electric Resistance of Glass.—G. Foussereau.—Tempering considerably reduces the electric resistance of the different glasses.

A Modification in the Bichromate Battery, rendering it more fit for the Electric Light.—M. Trouvé.—The author remarks that of all the batteries capable of producing the electric light, the bichromate is the only one which can be used advantageously, but it is very inconstant and its action is of very short duration. He overcomes this defect by supersaturating the solution of bichromate.

Combination-heats of the Glycolates.—D. Tommasi.—The author shows that the heats as determined experimentally by M. de Forcrand (*Comptes Rendus*, Feb. 26, 1883), agree with those calculated in accordance with the law of thermic substitution-constants. He gives also a table of the combination-heats of some glycolates, which have not yet been experimentally determined.

Mono-nitro-resorcin.—A. Fèvre.—The author obtains the sodium salt of this new compound by causing 1 mol. amyl nitrite to act in the cold upon 1 mol. mono-resorcin sodium. The sodium salt of the new compound is then decomposed by sulphuric acid. Free mono-nitroso-resorcin crystallises in gold-coloured needles which are blackened without fusion at 148°; they are very soluble in alcohol and acetone, less so in water, chloroform, and ether, and insoluble in benzol and carbon disulphide. With ferrous salts and iron filings the neutral solution gives a very intense green colour. The author has also obtained an amido-resorcin, a dinitro-resorcin, a dibromo-mono-nitroso-resorcin, and a dinitro-mono-resorcin. Nitroso-resorcin gives coloured reactions with all the phenols. With resorcin and sulphuric acid it forms the diazo-resorufine of Weselsky, which is now manufactured on the large scale at Bâle. The aromatic amines likewise give coloured products with nitroso-resorcin. That obtained by the action of nitroso resorcin upon dimethyl-aniline is of a violet colour, and has much analogy with the product obtained by Meldola from resorcin and nitroso-dimethyl-aniline.

Contributions to the Study of the Plastering of Wine: Rapid Determination of the Cream of Tartar.—P. Pichard.—In a saturated aqueous or alcoholic solution of potassium bitartrate, potassium sulphate and chloride (especially the latter) precipitate the tartrate. Hence, by the addition of potassium chloride to an unplastered wine, the tartar present may be approximately determined.

The Physiological Effects of Coffee.—J. A. Fort.—From a series of experiments the author concludes that coffee acts by exciting the central cerebro-spinal nervous system. In strong doses it produces sleeplessness, cramp, pains in the stomach, and disturbed action of the heart. It neither increases nor lessens the consumption of nitrogenous matter in the system.

Zeitschrift für Analytische Chemie.
Vol. xxii., Part 1, 1883.

Detection of Ammonia with Nessler's Test.—Otto Grothe and L. H. Friedburg.—This method does not succeed if the solution in question contains along with ammonia certain quantities of magnesium chloride.

Solubility of Magnesium Carbonate in Water Containing Carbonic Acid.—P. Engel and J. Ville.—From the *Comptes Rendus*.

Determination of Chromium in Chrome Iron.—H. N. Morse and W. C. Day.—6 to 10 grms. potassic hydrate are melted in a wrought-iron crucible (of the shape of an

ordinary porcelain crucible and of about 100 c.c. capacity) till the mass flows quietly, and are then allowed to go cold. Upon the surface of the congealed mass about 0.5 gm. of the finely-powdered sample is spread evenly, the potassa melted again, and frequently stirred with an iron rod. In two or three hours the decomposition is complete. The crucible is then laid on its side, and the temperature raised to dark redness. All the chrome is converted into chromic acid in about two to three hours. If the crusts in the crucible retain a green colour this is due to manganese. The cold mass is dissolved in hot water, and the solution heated for some time in order to precipitate any iron which has been dissolved. The filtrate is acidulated with nitric acid, and the alumina precipitated with ammonia. In the filtrate the potassium chromate is reduced, the silica is rendered insoluble by evaporation with hydrochloric acid. In the hydrochloric filtrate there remain merely chromium oxide and magnesia. The author precipitates the former with barium carbonate.

Opening up Chrome Iron.—H. Schwarz.—From *Liebig's Annalen*.

Volumetric Determination of Manganese.—C. G. Särnström proposes the following modification of Guyard's process:—To solutions of manganese he adds so much pure ferric chloride that manganese and iron may be present in approximately equal quantities. During titration the mixture must be stirred diligently, and if much manganese is present the liquid is heated to about 50°. When, on adding the permanganate solution, a red colour is produced which does not disappear, the end of the reaction is reached. The full process is as follows:—1 gm. pulverised manganiferous iron is covered in a beaker with 20 c.c. hydrochloric acid of sp. gr. 1.12, covered with a watch-glass, and boiled for half an hour. The liquid, evaporated down to one-half, is mixed with at least 5 c.c. nitric acid of sp. gr. 1.2, to peroxidise iron and to destroy any organic matter, heated to a boil, evaporated almost to dryness, 5 c.c. hydrochloric acid are added, and the whole boiled as long as orange vapours appear. The liquid is then tested for ferrous salt with potassium ferricyanide, otherwise the treatment must be repeated with 1 c.c. nitric acid. Silica and graphite are not to be filtered off unless they are to be determined or there is danger that the latter may be accompanied by a humoid body. The liquid is evaporated to dryness, the residue dissolved in 5 c.c. hydrochloric acid, heated to a boil, and diluted to about 100 c.c. A saturated solution of sodium bicarbonate is then added in small quantities, stirring diligently until all the iron is thrown down. After the escape of carbonic acid has ceased, the liquid is diluted to 200 c.c., and it is ready for titration.

Titration of Iron with Sodium Hyposulphite.—A. C. Oudemans, Jr.—Reserved for insertion in full.

Solubility of Silver Chloride and Bromide in Water.—J. P. Cooke.—From the *CHEMICAL NEWS*.

Detection of Mercury.—Biewend mixes the substance with twice its volume of finely-divided metallic copper, introduces the mixture into a test-tube of 15 m.m. in diameter, and introduces close above the mixture a small, brightly-polished, gold plate, rivetted to the end of a piece of steel watch-spring. The latter is bent in a zig-zag shape, so that it may press against the sides of the tube and hold the gold in its place. The tube is held in a slanting position, and cautiously heated from the bottom only, beginning with a moderate flame and raising the heat to incipient redness. The gold plate must not be allowed to become too hot. If the substance examined is bituminous, the plate of gold when taken out must be washed in alcohol before examination.

Volumetric Determination of Phosphoric Acid by Means of Uranium Solution.—K. Broockman and A. E. Haswell.—These authors show that the more uranium solution is used, the higher becomes its relative value.

Thus, according to Broockman, in quantities of 20 c.c., each c.c. represents 0.00498 grm. phosphoric acid; if 36 grms. are used, the value of each c.c. = 0.005125. Haswell confirms the principle, though in quantities of 20 c.c. he finds each c.c. = 0.005000 grm. phosphoric acid.

Spectroscopic Detection of Chlorine and Bromine.—Lecoq de Boisbaudran.—From the *Comptes Rendus*.

Determination of Hydrochloric, Hydrocyanic, Hydroferrocyanic, and Hydrosulphocyanic Acid when Jointly Present.—W. Borchers.—Reserved for insertion in full.

Quantitative Determination of Chloric Acid.—C. Stelling.—The author reduces the alkaline chlorates with a sufficiency of pure ferrous sulphate, supersaturates with potassa-lye free from chlorine, filters, acidulates the filtrate with nitric acid, and determines the chlorine. R. Fresenius points out the necessity of ascertaining in an aliquot part of the filtrate the total conversion of the chlorate into chloride. F. Becker effects the reduction, not in an alkaline, but in a neutral solution, adding potassa only enough to produce a slight precipitate of ferrous hydrate, and boiling for fifteen minutes, which completes the reduction.

Determination of Nitrous Acid along with Nitric Acid by Titration with Permanganate.—If nitrous acid is liberated by adding a stronger acid to the solution of a nitrite, the liquid must be largely diluted to prevent a partial decomposition of the nitrous acid. Lorenz and Kübel show that this method is not accurate if the titration of the permanganate has been effected by means of a ferrous salt or of oxalic acid.

Absorption-spectra of Certain Organic Liquids.—C. H. Wolff.—Hammarsten and Rolbert have shown that traces of thymol may be recognised by the splendid red colour obtained on heating with glacial acetic acid and sulphuric acid. This liquid, according to Wolff, has an absorption-spectrum very similar to that of oxy-hæmoglobine, but with reversed intensity. There is a broad, dark band about Fraunhofer's line E, extending from the wave-length 495 to 560, and a fainter and narrower at D. Wolff confirms the statement of Schack on the absorption-spectrum of the blue liquid obtained by the action of acetic acid upon oil of peppermint. The red colour which, according to Lustgarten, is obtained by the action of an alkaline solution of resorcin upon iodoform, is characterised by a strong absorption-band, almost identical with the darker of the two described under thymol.

Reactions for the Detection of Naphthol, Chloroform, and Iodoform.—S. Lustgarten.—If naphthol is dissolved in strong potassa-lye, a little chloroform or chloral hydrate added, and the mixture gently heated, the liquid, even with very small quantities of naphthol, assumes a transitory blue colour. The reaction can be applied inversely for the detection of small quantities of chloroform. Iodoform, if heated with phenol-potassium or resorcin-potassium, forms rosolic acid, the liquid assuming a red colour, which disappears on the addition of an acid. This reaction serves to recognise substances which, on treatment with iodine and alkali, constitute, or give rise to, iodoform, *c.g.*, ethylic alcohols.

Detection of Malic Acid.—MM. Papasogli and Poli.—On boiling with a few drops of malic acid and a little potassium dichromate, malic acid may be recognised by the smell of fresh apples.

Recognition of Tertiary Alcohols.—C. Hell and Fr. Urech.—The authors use a mixture of carbon disulphide and bromine. On prolonged contact with this mixture the tertiary alcohols form the bromide of the alcohol-radicle, hydrobromic acid and oxygen, which reacts upon the carbon disulphide, so that if the mixture is poured into much water, sulphuric acid is found in quantity. The primary and secondary alcohols do not exhibit this reaction, but, in presence of water and of organic acids, carbon disulphide is oxidised by bromine.

The Behaviour of Gluconic, Saccharic, Lactonic, and Mucic Acids.—H. Kiliani.—The above acids do not reduce the copper solution.

Saccharine.—Léon Cuisinier.—From the *Moniteur Scientifique*.

Colchicine and its Decomposition-Products.—J. Hertel.—This paper, with the accompanying table, does not admit of useful abstraction.

Alkaloids of Quebracho Bark.—O. Hesse.—From *Liebig's Annalen*.

Determination of Carbon and Hydrogen by Combustion in a Current of Oxygen.—M. Etard.—The author places the boat not in direct contact with the glass of the combustion-tube, but upon a trough-shaped piece of platinum foil, perforated with many holes. Instead of granular copper oxide he fills the front part of the tube with fragments of pumice which have been steeped in copper nitrate and ignited.

Combustions with Lead Chromate.—H. Ritthausen.—From the *Journal für Praktische Chemie*.

Determination of Nitrogen in Organic Compounds.—Hubert Grouven.—The author passes over the substance, superheated steam at 400° to 700°, which incinerates it, and converts the nitrogen partly into ammonium carbonate and partly into volatile nitrogenous compounds, which are then fully transformed into ammonium carbonate by passing over an ignited stratum of Grouven's "contact mass,"—a mixture of peat, potters' clay, and "meadow-chalk." The ammonium carbonate is conducted into a recipient containing normal acid, and the excess acid is determined volumetrically. [The author has taken the step—without precedent, we believe, on the Continent—of patenting this process!—*Ed. C.N.*]

Solubility of Sodium Benzoate in Alcohol.—H. Hager.—1 part of benzoic acid, from whatever source, dissolves in 13 parts of alcohol at 90 per cent.

Solubility of Tartar in Water.—C. v. Babo and C. Portele.—The authors give a table of the solubility of tartar in water from 0° to 100°.

Specific Gravity of Aqueous Solutions of Tartar Emetic.—G. Streit has drawn up a table of the specific gravities of potassium antimony tartrate in solutions containing from 0.5 to 6.0 per cent, and at the temperature of 17.5°.

Analysis and Elementary Composition of Starch.—F. Salomon.—From the *Journal f. Praktische Chemie*.

Optical Rotatory Power of Organic Substances.—Under this head are briefly mentioned a number of researches, for which we must refer to the original.

Carbonic Acid in the Atmosphere.—MM. Marié-Davy, A. Muntz, and E. Aubin.—From the *Comptes Rendus*.

Analysis of Wines.—Here are briefly summarised methods for the determination of extract and glycerin, by R. Kayser; for the examination of plastered, "Chaptalised," "Petiotised," and "Gallised" wines, by the same author; for the detection of red colouring-matters, by J. de Groot, P. Pastrovich Lambert, and Ch. Thomas.

Determination of Tartaric Acid.—R. Kayser.—The author recommends the method of Nessler and Barth (*Zeitschrift f. Anal. Chemie*, xxi., p. 61). In opposition to Schmitz and Nessler, Mering maintains the harmlessness of the non-fermentible constituents of potato-sugar as used in artificial wines. Schmitz upholds his former experiments and the conclusions to which they lead.

Examination of Coffee.—C. Krauch has examined the specific gravity of decoctions of coffee and its adulterants, and has come to results closely agreeing with those of Graham, Stenhouse, and Campbell. Skälweit has drawn up a table for determining the sp. gr. of extract of coffee at different degrees of concentration.

Detection of Fusel in Commercial Alcohol.—H. Marquardt.—The author dilutes 150 grms. of the alcohol to be examined with water so as to bring it to from 12 to 15 per cent of actual alcohol. He shakes it up with 50 c.c. chloroform for fifteen minutes, and draws off the chloroform. This process is repeated three times. The chloroform extracts are mixed together, and shaken up three times with an equal volume of water for fifteen minutes, in order to remove alcohol. The chloroform which now contains no alcohol, but all the fusel, is mixed with a solution of 5 grms. potassium bichromate in 30 grms. water and 2 grms. sulphuric acid, and heated for six hours to 85° on the water-bath in a strong, well-corked bottle, shaking frequently. When the oxidation is complete the contents of the flask and the washings are introduced into a distillation-apparatus, and distilled down to 20 c.c. To the residue about 80 c.c. of water are added, and the mixture is again distilled down to 5 c.c. The distillate is mixed with barium carbonate, and digested for about thirty minutes in a reflux cohobator. The chloroform is distilled off, the residue is evaporated on the water-bath down to about 5 c.c., freed from the excess of barium carbonate by filtration, washed, and the filtrate is evaporated to dryness on the water-bath. The residue is dissolved with water and a few drops of nitric acid, so as to make up 100 c.c. In 50 c.c. the barium is determined, and in the other 50 c.c. the chlorine. The quantity of barium chloride corresponding to the chlorine is deducted from the total residue, and from the baryta of the rest the quantity of the fusel is calculated so that 2 mols. amylic alcohol represent 1 mol. baryta.

Determination of Nitrogen in Nitric Ethers.—F. Hess.—This memoir cannot be reproduced without the three accompanying illustrations.

Volumetric Determination of Ferrocyanogen in Crude Potassium Ferrocyanide.—J. Tcherniac.—This memoir is reserved for insertion in full.

Determination of the Cinchona Alkaloids.—Reserved for insertion in full.

Determination of Urea in the Blood.—W. v. Schröder.—This memoir does not admit of useful abstraction.

Detection of Nitrous Acid in Blood.—G. Bertoni and C. Raimondi.—The authors make use of the principle of dialysis. Nitrites, if present, diffuse into the water outside, whilst the albumenoid matters are retained.

Detection and Separation of Phenols and Aromatic Oxy-acids in Urine.—E. Baumann.—For this important memoir we refer to the *Zeitschrift f. Physiologische Chemie*, vi., p. 183.

Determination of Sugar in Diabetic Urine.—H. H. Antweiler and P. Breidenbend.—The authors seek to calculate the quantity of fermented sugar either from the quantity of alcohol formed, or from the decrease of the specific gravity of the fermented liquor.

Detection of Arsenic in Textile Goods, &c.—Emil Lyttkens oxidises the swatch (440 square c.m. of printed goods, wall-papers, &c., or 220 square c.m. of dyed tissues) by treatment with dilute sulphuric acid and potassium chlorate. Any arsenic acid formed is reduced by the addition of sodium sulphite, filtered, and treated with a current of sulphuretted hydrogen. After twelve hours the mixture is filtered again, the precipitate is treated on the filter with a warm solution of ammonium carbonate, and the solution of arsenious sulphide thus obtained, along with small quantities of organic matter, is evaporated to dryness on the water-bath, and treated again with sulphuric acid and potassium chlorate, and the liquid thus obtained is heated till it is free from chlorine and colourless. It is then introduced into a Marsh apparatus, and the reduction-tube is kept ignited for twenty minutes.

Contributions to the Forensic Chemistry of the Vegetable Alkaloids.—These refer to the alkaloids of

quebracho bark; to those of the Pereiro bark; and the alkaloids of gelsemium root.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3e Série. Tome x., January, 1883.

Purification of Graphitoid Carbon and the Preparation of Pure Carbon for Electric Lighting.—M. Jacquetain.—The luminous power and the fixity of the Voltaic arc of a pure carbon, obtained either directly or by purification, increases at the same time as its density, its hardness, and its purity. The native graphitoid carbon of Siberia has the property of acquiring by purification a luminous power double that which it presents in the natural state, and surpassing by one-sixth that of pure artificial carbons.

Bulletin de la Société Chimique de Paris.
No. 5, March 5, 1883.

Thermometric Measurements and the Determination of Melting- and Boiling-Points.—J. M. Crafts.—Noticed under *Comptes Rendus*, vol. xci., xciv., and xcv.

A New Ammonium-Cobaltic Compound.—L. Maquenne.—On treating Fremy's oxy-cobaltic sulphate with sulphuric acid diluted with water and alcohol, the author obtains a rose-coloured powder, which, if treated with an excess of chlorine water, is transformed into a green crystalline product, sparingly soluble in water. This compound is a cobaltamine sulphate. It is rapidly decomposed by boiling water and alkalies, but dissolves in dilute acids without immediate decomposition.

Cosmos Les Mondes.

Nos. 10 and 11, March 10 and 17, 1883.

These numbers contain no chemical matter.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Anhydrous Ammonia.—(Reply to T. P.)—Send particulars of requirements to E. G. M., 3, Unity Street, Bristol.

Gas Purification.—Can any of your readers inform me of a good way of purifying common coal-gas. That which I have to use is very impure, the products of combustion being disagreeable and irritating. The amount used is equal to about twenty Bunsen's burners.—R. H.

MEETINGS FOR THE WEEK

MONDAY, April 16.—Medical, 8.30.

— Society of Arts, 8. Cantor Lectures. "The Decorative Treatment of Metal in Architecture," by George H. Birch, A.R.I.B.A.

TUESDAY, 17th.—Institution of Civil Engineers, 8.

— Pathological, 8.30.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.

WEDNESDAY, 18th.—Society of Arts, 8. "The Government Patent Bill," by H. Rueman Wood, B.A.

— Meteorological, 7.
THURSDAY, 19th.—Royal Institution, 3. "Art of Pheidias," by Dr. Waidstein.

— Royal, 4.30.
— Royal Society Club, 6.30.
— Chemical, 8. Ballot for the Election of Fellows.
"Note on an Apparatus for Fractional Distillation under Reduced Pressures," by Mr. L. T. Thorne.

FRIDAY, 20th.—Royal Institution, 8. "The Island of Socotra," by Prof. Balfour, at 9.

— Society of Arts, 8. "The Fisheries of India," by Surgeon-General Francis Day.

SATURDAY, 21st.—Royal Institution, 3. "Geographical Evolution," by Mr. A. Geikie.

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THE CHEMICAL NEWS.

VOL. XLVII. No. 1221.

ON THE ATOMIC WEIGHT OF GLUCINUM (BERYLLIUM).*

By T. S. HUMPIDGE, Ph.D., B.Sc.

IN this paper the author shows that no conclusions with respect to the atomic weight of glucinum can be drawn from analogy of its compounds with those of other metals, and that this long-disputed question can only be decided by the specific heat of the metal or by the vapour-density of some of its volatile compounds. Two determinations of the specific heat have been made by Professor E. Reynolds and M. Nilson, the former of whom obtained a result of about 0.6, and the latter only about 0.4. The probable inaccuracies in Professor Reynolds's apparatus are pointed out, and it is shown that his metal was probably very impure.

The author has prepared metallic glucinum from the chloride, the vapour of which was passed over sodium contained in iron boats in a glass tube. A metal was thus obtained which had the composition:—

Gl	93.97
Gl ₂ O ₃	4.71
Fe	1.32
Si	traces
	100.00

and was probably the purest yet prepared.

The specific heat was determined by a modification of Regnault's method of mixtures, using electrical appliances to avoid the necessity of an assistant. Three determinations of the specific heat of silver in water, made to test the apparatus, gave the following results:—

I.	0.05677
II.	0.05571
III.	0.05556
Mean	0.05601

and with a mean error of only 0.6 per cent. The specific heat of metallic glucinum was determined in turpentine,

Strength of the sol. taken.	20 per cent.	10 per cent.	2.5 per cent.	1.28 per cent.	Various.	Theory for 6CuO, 2SO ₃ , 5H ₂ O.
CuO	63.323	65.743	65.083	65.289	64.535	65.502
SO ₃	23.301	23.378	22.967	22.368	23.258	22.083
H ₂ O	13.376	10.879	11.950	12.343	12.207	12.415
CuO in the anhydrous substance	73.101	73.768	73.916	74.4	73.508	74.787

of which the specific heat was found to be 0.4231, and with the following results:—

I.	0.4326
II.	0.4264
III.	0.4357
Mean	0.4316

and with a mean error of 0.9 per cent. Making a correction for the impurities contained in the metal, its true specific heat would be 0.4455, whence if the atomic weight is 13.65, the atomic heat becomes 6.07. This must, therefore, be the true atomic weight, and not two-thirds of this, or 9.1.

The number found by Nilson was somewhat lower than this (0.4079), and the above results may be too high, firstly, from hygroscopic moisture, and secondly, from

heat produced when the liquid was absorbed by the porous metal. About 0.67 grm. of the metal was used for the determinations, and it was compressed to a compact disk in a steel mortar.

The author is continuing the research.

ON THE BASIC SULPHATES OF COPPER.

By SPENCER UMFREVILLE PICKERING, B.A. (Oxon.),
Lecturer in Chemistry at Bedford College.

ACCOUNTS of an investigation on the basic sulphates of two pseudo-triad metals, aluminium and iron, have already appeared in the CHEMICAL NEWS (vol. xlv., p. 121), and in those of the *Journal of the Chemical Society* (1880, p. 807), the general result arrived at being to show that these two metals did not form the large number of basic sulphates which they were supposed to do.

An investigation of the sulphates of a metal belonging to a different class, namely, copper, has since been made, and the results of this investigation, as here detailed, show that this metal forms two instead of six basic sulphates.

The basic precipitates dealt with were analysed either without being dried, as in former cases, or were exposed to the air till they became constant in weight, which they did very soon, the water retained by them being determined by difference.

In some of the earlier experiments the numbers obtained were vitiated to a certain extent by the basic precipitates not having been sufficiently washed before analysis, as it was subsequently found that they required a very prolonged washing, and that it was impossible to ascertain when that washing was complete, owing to the fact that the basic salt itself dissolved in water to a certain extent. Various test analyses showed that the average experimental error amounted to about ± 0.2 per cent.

I. Copper Sulphate Solution Boiled.

On boiling a neutral solution of copper sulphate a small quantity of a greenish-blue deposit is invariably formed. The formation of this deposit is complete in about ten minutes, and is not due to any of the acid being carried away in the current of steam. In the various experiments made the copper in the precipitates amounted to between 2.5 and 0.37 per cent of the total copper present, the amount precipitated increasing with the dilution of the solution. The following analyses were made:—

Strength of the sol. taken.	20 per cent.	10 per cent.	2.5 per cent.	1.28 per cent.	Various.	Theory for 6CuO, 2SO ₃ , 5H ₂ O.
CuO	63.323	65.743	65.083	65.289	64.535	65.502
SO ₃	23.301	23.378	22.967	22.368	23.258	22.083
H ₂ O	13.376	10.879	11.950	12.343	12.207	12.415
CuO in the anhydrous substance	73.101	73.768	73.916	74.4	73.508	74.787

These analyses do not agree very well with the theoretical numbers—the water being rather variable, and the copper oxide percentages being too low,—this, however, is probably due to causes mentioned in the next paragraph; and we may safely conclude that a definite basic salt, namely, 6CuO, 2SO₃, 5H₂O is precipitated in this way.

II. Precipitation of Copper Sulphate by Potassium Hydrate in the Cold.

The results of a series of experiments on the addition of pure potassium hydrate to a cold solution of copper sulphate are given in Table I.

It is there seen that when the amount of potassium hydrate added is less than 1.5 molecule to every molecule of the sulphate present the precipitate is light blue in colour and in composition approximates to 4CuO, SO₃, which contains 79.798 per cent CuO; but that when the

* Abstract of a Paper read before the Royal Society, April 12, 1883

amount of alkali added is greater, the precipitate is bulky and of a dark blue colour, and then, on being kept, washed, or warmed, becomes more or less black, evidently containing uncombined copper hydrate.

The numbers in the third column vary considerably, but in no definite direction, and are all lower than 79.798, but this irregularity and non-concordance with the theoretical numbers is due to the precipitates not having been washed sufficiently, as is shown by the following considerations and experiments.

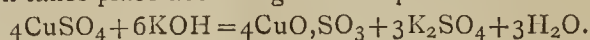
In the case of those precipitates mentioned in Table I., which approached more nearly in composition to $4\text{CuO}, \text{SO}_3$, namely, Nos. 7, 10, 11, 12, 14, four of these had been washed two or three times as much as the others.

A precipitate, similar to No. 8, which had been washed with $5\frac{1}{2}$ litres of water, was found on analysis to contain 79.675 per cent CuO.

Another similar precipitate, after being twice boiled with 150 c.c. of water, gave the percentage of CuO as 79.499.

The precipitates obtained by the action of an acetate as described below, appear to be exactly similar to those obtained here, except that they are more easily washed, and they approach more nearly to the composition indicated by the formula $4\text{CuO}, \text{SO}_3$.

On the whole, there can be little doubt but that the addition of potash to a solution of copper sulphate precipitates a definite basic salt, as long as the proportion of alkali added does not exceed 1.5 molecule for each molecule of copper sulphate present, and that, therefore, the action takes place according to the equation—



Tetra-basic copper sulphate dissolves in water to a small extent, one litre of cold water taking up about 0.017 gm. of the salt; and this solution, on concentration at a boiling heat, becomes dark, owing to the separation of copper hydrate.

The basic salt was never found to contain any appreciable quantities of potassium sulphate, or of carbonate, provided it had been thoroughly washed; and it was also found to remain quite unaltered in colour, and to absorb no carbon dioxide when exposed to the air for an indefinite period, but when kept in a solution of carbon dioxide an appreciable amount of carbonate was formed in the course of a few days. Protracted immersion in boiling water did not affect it in the least.

III. Precipitation of Copper Sulphate by Potassium Hydrate while Boiling.

In order to ascertain the true nature of the precipitate obtained by adding potassium hydrate to a boiling solution of copper sulphate, it was necessary to boil this latter solution for about 15 minutes and filter before adding the alkali, as otherwise some of the basic sulphate, $6\text{CuO}, 2\text{SO}_3$, would have been formed by the boiling itself, and would have vitiated the results. On the addition of the potassium hydrate a black precipitate of copper hydrate is first formed, which soon changes to a greenish-blue solid; the results of various analyses of this substance are given in Table II., the numbers in which will be seen to correspond pretty well with those for $7\text{CuO}, 2\text{SO}_3, 7\text{H}_2\text{O}$; the CuO percentages, however, are higher than the theoretical numbers, whereas, owing to the difficulty of efficient washing, and owing to the probable contamination with a certain quantity of $6\text{CuO}, 2\text{SO}_3$, the results would be expected to be lower. The analytical numbers, moreover, correspond sufficiently closely with those given in Table I. to warrant the conclusion that the same substance, namely, $4\text{CuO}, \text{SO}_3$, is obtained in both cases, and that, therefore, the existence of $7\text{CuO}, 2\text{SO}_3$ is more than doubtful.

These analyses, together with others performed on precipitates obtained by the action of potash on cold copper sulphate solution, show that this tetra-basic sulphate, when dried by exposure to air, is combined with $4\text{H}_2\text{O}$; in

one solitary instance, however, the analysis showed the presence of $4\frac{1}{2}\text{H}_2\text{O}$.

The same basic salt when obtained by the action of an acetate (*vide infra*) was found to retain only $2\text{H}_2\text{O}$, and this hydrate remained unaltered on being heated in a current of dry air at 100°C .

IV. Precipitation by Sodium Acetate.

When a solution of sodium acetate is added to one of copper sulphate, a light blue flocculent precipitate is first formed, which, after a time, becomes granular, and this change in appearance may be much accelerated by the application of heat.

Some experiments on the composition of the precipitates thus produced in the cold are given in Table III. From this table it will be seen that the basic precipitate here obtained is the same in every case, and corresponds within experimental error to $4\text{CuO}, \text{SO}_3$ (which contains 79.798 per cent CuO), the greater accuracy of the numbers here as compared with those given in Table I. being attributable to the fact that these precipitates are more easily washed than those obtained by potash.

It will also be seen that the amount of precipitate eventually obtained is only slightly increased by a considerable increase in the amount of acetate or water added, but that the precipitation is retarded by an increase in the amount of the former and accelerated by an increase in the amount of the latter.

The reaction here may be represented by the equation—

$$4\text{CuSO}_4 + 6\text{C}_2\text{H}_3\text{NaO}_2 + 3\text{H}_2\text{O} = 4\text{CuO}, \text{SO}_3 + 3\text{Na}_2\text{SO}_4 + 6\text{C}_2\text{H}_4\text{O}_2,$$

but is never nearly complete, owing to the solution of some of the basic sulphate in the hydrogen acetate liberated.

When the precipitation is aided by heat, the only alteration effected is an increase in the amount of the precipitate obtained, thus:—

Experiment 8 was repeated at 60°C . After an hour and a half the precipitation at this temperature was complete, when about 30 per cent of the copper present was found to have been precipitated as a basic sulphate containing 79.931 per cent of CuO; the filtrate on being subsequently boiled for twenty minutes gave nearly the same amount of precipitate containing 79.45 per cent of CuO. Again, on repeating experiment 8 at 100°C ., a precipitate containing 79.384 per cent of CuO was obtained. Other experiments gave similar results.

In some cases where the precipitate is obtainable only by the protracted boiling of the solution, it is found to be deposited in minute shining crystalline scales.

V. Copper Sulphate heated.

About 5 grms. of the normal sulphate were heated gently in a platinum dish with constant stirring, the dish being weighed at intervals of about fifteen minutes. After all the combined water had been expelled, black particles began to make their appearance, and these increased in quantity till the experiment was concluded, when the resulting mass was found to contain 94.3 per cent of CuO, and was evidently nothing but a mixture of insoluble copper oxide and soluble undecomposed sulphate. The loss in weight was continuous throughout, and no indications of any definite basic sulphate being formed in this way could be obtained.

VI. Dilution of Ammonio-Copper Sulphate.

A solution of ammonio-copper sulphate was prepared by adding ammonia in slight deficit to a solution of copper sulphate, and filtering; the solution thus obtained was found to contain 0.02615 gm. of CuO per c.c.

When water in various proportions was added to this liquid a precipitate of basic copper sulphate was thrown down, which varied in colour and appearance according to the proportion of water added. With small quantities the precipitate was of a moderately light blue colour and

TABLE I.—PRECIPITATION OF COPPER SULPHATE BY POTASSIUM HYDRATE IN THE COLD.

	Molecules of KOH to each mol. of CuSO_4 .	Molecules of Water present.	P.c. of Cu precipitated. (That taken=100).	P.c. of CuO in the Precipitate obtained.	Remarks.
1.	0'156	760	10'8	78'109	Light blue.
2.	0'235	760	16'3	77'877	"
3.	0'351	300	24'3	77'908	"
4.	0'466	760	33'9	78'461	"
5.	0'466	760	—	78'452	"
6.	0'674	760	46'6	77'023	"
7.	0'674	300	—	79'156	"
*8.	0'710	760	—	78'189	"
*9.	0'710	760	—	78'625	"
†10.	0'925	760	—	79'224	"
†11.	0'925	760	—	79'000	"
12.	0'925	760	69'8	78'709	"
13.	0'925	300	68'1	78'272	"
14.	1'400	760	98'1	78'631	"
15.	1'720	760	—	—	Dark blue; bulky.
16.	1'840	760	—	—	" "
17.	1'940	760	—	—	" "
18.	1'974	760	100'0	99'524	" "
19.	4'000	760	100'0	100'000	" "

* & † Duplicate analyses.

TABLE II.—PRECIPITATION OF COPPER SULPHATE BY POTASSIUM HYDRATE AT 100° C.

	Molecules of KOH to 1 molecule CuSO_4 .	Strength of the CuSO_4 solution.	The Hydrated Precipitate contained			P.c. CuO contained by the Anhydrous Precipitate.
			P.c. CuO.	P.c. SO_3 .	P.c. H_2O .	
1.	0'01	2'1	65'593	18'547	15'860	77'957
2.	0'01	2'1	66'687	18'012	15'301	78'734
3.	0'02	0'6	—	—	—	77'915
4.	0'02	0'6	66'027	19'029	14'944	77'449
5.	0'04	1'07	—	—	—	78'712
7CuO, 2SO ₂ , 7H ₂ O contains—			65'944	19'056	15'000	77'360
4CuO, SO ₃ , 4H ₂ O contains—			67'554	17'081	15'365	79'798

TABLE III.—PRECIPITATION OF COPPER SULPHATE BY SODIUM ACETATE IN THE COLD.

	Molecules of Sodium Acetate to each molecule of Copper Sulphate.	Molecules of Water present.	Percentage of Cu in the Ppt. as compared with the total amount taken.	Percentage of CuO in the Anhydrous Precipitate.	Remarks.
			Filtered after 22 days.		
1.	0'54	800	12'0	79'831	A good deal of ppt. after 2½ hrs.
2.	1'64	800	22'6	79'738	Slightly cloudy after 2½ hrs.
3.	8'22	800	26'0	79'794	Questionably cloudy after 15 hrs.
4.	1'64	200	15'0	79'417	No cloudiness after 15 hrs.™
5.	1'64	800	22'6	79'738	Slightly cloudy after 2½ hrs.
6.	1'64	4000	24'0	78'255 (?)	Slightly cloudy at once.
			Filtered after 1 day.		
7.	1'36	1300	13'0	79'614	
8.	2'72	1300	15'0	79'624	

TABLE IV.—DILUTION OF AN AMMONIO-COPPER SULPHATE SOLUTION WITH WATER.

	Molecules of Water added to each atom of Copper.	Copper in the Ppt. (That in the sol. taken = 100).	Percentage of CuO in the Anhydrous Precipitate.	Appearance of the Precipitate.
1.	1700	42'7	91'58	Light blue.
2.	5100	85'5	92'128	Dark blue and bulky.
3.	8500	96'3	92'80	" "
4.	17000	97'0	93'15	" "
5.	1020	—	—	No precipitate after 15 mins.
6.	1360	14'4	88'664	Very light blue, not bulky.
7.	3400	70	91'588	Light blue, rather more bulky.
8.	8500	90	92'351	Dark blue and bulky.
9.	34000	94	93'857	" "
10.	72000	94	94'389	" "

compact, while with larger quantities the precipitate was very dark blue and bulky, similar to copper hydrate at the moment of its precipitation. In no cases did they contain more than minute traces of ammonia.

Two series of experiments on this subject were performed, the results of which are given in Table V. The experiments in the two series are concordant in themselves, but those of one series are not strictly comparable with those of the other series, inasmuch as they were not performed at exactly the same temperature. It will be seen that these precipitates do not consist of any definite chemical compound, but they increase in basicity with an increase in the quantity of water added, while, even with the smallest amount of dilution which suffices for obtaining an appreciable precipitate, this latter is considerably more basic than $4\text{CuO}, \text{SO}_3$, which contains 79.798 per cent of CuO . The amount of the precipitate obtained increases rapidly at first with an increase in the dilution, but afterwards very slowly.

VII. Copper-Oxide, Hydrate, and Basic Sulphate treated with Solutions of the Normal Sulphate.

When any of the precipitates which correspond in composition to $4\text{CuO}, \text{SO}_3$ are boiled with water for an indefinite time they undergo no blackening nor change in colour, whereas, when those containing a larger percentage of CuO are similarly treated, they become more or less quickly blackened. This reaction, therefore, serves to distinguish the definite sulphate $4\text{CuO}, \text{SO}_3$ from a substance containing a larger percentage of copper oxide.

A precipitate obtained by the dilution of some ammonio-copper sulphate solution in an experiment similar to 3, Table V., was boiled for 10 minutes with a strong solution of the normal sulphate; it was then found to be changed from a dark bulky substance to a light blue pulverulent one, which, on being tested by boiling with water, remained entirely unchanged, and which, on analysis, yielded results proving it to consist entirely of pure 4CuOSO_3 . On repeating this experiment with cold solutions the basic salt obtained was found to vary in composition between $4\text{CuO}, \text{SO}_3, 4\text{H}_2\text{O}$, and $6\text{CuO}, 2\text{SO}_3, 5\text{H}_2\text{O}$, consisting, no doubt, of a mixture of these two definite salts.

A precipitate obtained by the addition of a slight excess of potassium hydrate to a solution of copper sulphate was found to be completely converted into $4\text{CuO}, \text{SO}_3$ by digestion with a cold 10 per cent solution of the normal sulphate for some hours.

A sample of precipitated copper hydrate, which had been dried at 100°C ., underwent a similar but slower change on digestion with cold or boiling strong solution of copper sulphate, while with some copper oxide obtained by the ignition of the nitrate no change whatever could be induced.

From the fact that in these experiments a deposit was always observed on the sides of the containing vessel it would appear probable that the change is effected by the solution of the copper hydrate or basic sulphate in normal sulphate and its subsequent deposition as $4\text{CuO}, \text{SO}_3$.

VIII. Conclusion.

From the work detailed above it will be seen that two definite basic sulphates of copper are obtainable:— $6\text{CuO}, 2\text{SO}_3, 5\text{H}_2\text{O}$, by boiling a solution of the normal salt, and $4\text{CuO}, \text{SO}_3, 2\text{H}_2\text{O}$, by the precipitation of copper sulphate by a deficit of potassium hydrate, by the decomposition of copper sulphate by an acetate, and by the action of a solution of the sulphate on copper hydrate. In addition to which it has been shown that on heating the normal sulphate no definite basic salt can be obtained, and that by the dilution of a solution of ammonio-copper sulphate a basic precipitate of varying composition is thrown down.

The following is a list of the more important papers bearing on this subject:—

THOMSON, *Ann. Phil.*, xvii., 244.

ROUCHER, *Journ. Pharm.* [3], xxxvii., 249.

J. DENHAM SMITH, *Chem. Soc. Mem.*, i., 1843, 221.

FIELD, *Phil. Mag.* [4], xxiv., 123.

VOGEL and REISCHAUER, *N. Jahrb. Pharm.*, xii., 345.

CASSELMANN, *Zeitschr. Anal. Chemie*, iv., 24.

KANE, *Irish Acad. Proc.*, i., 182.

KÜHN, *Schw.*, lx., 343.

PROUST, *Ann. Chim.*, xxxii., 34.

BERZELIUS, *Gilb. Ann.*, xl., 300; *Jahrb.* xi., 176.

GRAHAM, *Ann. Pharm.*, xxix., 29.

BRUNNER, *Pogg. Ann.*, xv., 479.

REINDEL, *Journ. Prakt. Chem.*, c., 1.

ON THE

USE OF ROSOLIC ACID AS AN INDICATOR, WITH ADDITIONAL NOTES ON THE USE OF PHENOL-PHTHALEIN & METHYL-ORANGE.*

By ROBERT T. THOMSON.

THE following notes are simply an addition to my former paper on the use of litmus, methyl-orange, phenacetolin, and phenol-phthalein as indicators. The object in view, as I stated before, was to determine the value of each indicator when applied to the estimation of alkalies and free acids, and to ascertain the effect (if any) of the impurities—such as sulphites, sulphides, phosphates, &c.—usually found in commercial hydrates and carbonates of the alkalies. The tests were carried out in precisely the same way as described in the former part of this paper.

(1.) *Delicacy of Rosolic Acid in Absence of Interfering Agents.*—The solution employed contained 2 grammes of rosolic acid per litre, 50 per cent alcohol being the solvent used. To test the delicacy of this indicator, 0.5 c.c. of its solution was added to 100 c.c. of distilled water, and decinormal hydrate of sodium (1 c.c. = 0.0031 gramme Na_2O) dropped in. To effect the complete transformation of the pale yellow to a deep pink colour only 0.1 c.c. of the standard alkali was required. This is equal to 0.01 c.c. of normal alkali, and this figure should be borne in mind for the sake of comparing the delicacy of the rosolic acid in absence of interfering agents with its delicacy in presence of the salts to be examined.

(2.) *Application of Rosolic Acid to the Determination of Available Alkali in Pure Hydrate, Carbonate, and Bicarbonate of Sodium and Potassium.*—It is hardly necessary to give a detailed account of this portion of the subject. Several tests were made with quantities of the hydrate and carbonate of sodium and potassium containing 1.55 grammes of Na_2O and 2.355 grammes of K_2O respectively, with the result that exactly these amounts were obtained in each case, by titration with normal sulphuric acid. The deep pink colour retains its original intensity up to the point at which bicarbonate of sodium is produced, but soon gives place to pale yellow, owing to the action of the liberated carbonic acid. It is therefore necessary to boil the solution thoroughly after each addition of acid to bring back the pink colour, and when this is attended to the end-reaction is extremely delicate, and can be effected by at least one drop (about 0.05 c.c.) of normal acid.

(3.) *Determination of Free Ammonia.*—Several experiments, made in each case with a solution containing 0.85 gramme of ammonia (NH_3), gave identical and accurate results. The pink colour remained undiminished in intensity until 49.8 c.c. of the normal acid had been consumed, but on further addition of acid drop by drop, the pink slowly acquired a yellow tinge, and when 50 c.c. had been added the former was wholly eliminated, leaving only the pale yellow colour; but although this is the case the end-reaction is tolerably distinct. This decrease in delicacy of the rosolic acid is not due to carbonic acid, as the ammonia employed did not contain an appreciable quan-

* A Paper read before the Philosophical Society of Glasgow (Chemical Section), March 19, 1883.

tity of carbonate, but, as I shall show presently, is owing to the action of the salt of ammonium formed. Rosolic acid has been specially recommended as an indicator for ammonia determinations, but it is evident that it has no peculiar value for that purpose, even the much-abused litmus being considerably superior to it.

(4.) *Effect of Sulphate, Chloride, and Nitrate of Sodium, Potassium, and Ammonium.*—The quantities of these salts operated upon were exactly equivalent to 1.55 gramme of soda (Na_2O), 2.355 grammes of potash (K_2O), and 0.85 gramme of ammonia (NH_3) respectively. The presence of these salts of sodium and potassium does not sensibly affect the delicacy of the rosolic acid, but each of the salts of ammonium required 0.2 c.c. of normal hydrate of sodium to develop fully the deep pink colour, as against 0.01 c.c. when tested with distilled water alone.

(5.) *Effect of Sulphite of Sodium.*—The remainder of the experiments were made only on sodium salts, as I did not think it necessary to examine further the potassium and ammonium salts. Two tests were made with 3.15 grammes of normal sulphite of sodium, which contain 1.55 gramme of soda (Na_2O). When titrated in the cold only 0.2 c.c. of normal sulphuric acid was required in both cases to destroy the pink colour, but when boiled 5 and 5.2 c.c. were respectively necessary, the results being in the cold 0.006, and in the hot 0.155 and 0.161 gramme of soda (Na_2O). On cooling the boiled solution and titrating back with normal soda, 4.8 c.c. were required to restore the pink colour. From these results it is evident that normal sulphite of sodium (Na_2SO_3) is practically neutral to rosolic acid in the cold, which it also is, as I showed before, to phenol-phthalein, while to methyl-orange, litmus, and phenacetolin the bisulphite (NaHSO_3) is the neutral salt. It is noteworthy that the two last-named indicators give with the sulphite very undecided end-reactions, while the three former give very sharp and well defined end-reactions.

(6.) *Effect of Thiosulphate of Sodium.*—This salt is perfectly neutral to rosolic acid.

(7.) *Effect of Sulphide of Sodium.*—The whole of the sodium in this compound is accurately estimated by standard sulphuric acid, with rosolic acid as indicator. The pink colour retained its original intensity until the sodium hydrogen sulphide (NaHS) was formed, but on further addition of acid gave place to yellow, owing to the action of the liberated sulphuretted hydrogen. On boiling, the pink colour returned, and a very sharp end-reaction was secured. It is only necessary to state that the results agreed substantially with those obtained with methyl-orange and litmus.

(8.) *Effect of Phosphate of Sodium.*—Two tests were made with 1.775 grammes of mono-acid ortho-phosphate of sodium, which contains 0.775 gramme of soda (Na_2O). In one case 12.0 c.c., and in the other 12.2 c.c., of normal acid were necessary to complete the change from deep pink to yellow. As the transformation in colour was gradual the end-reaction was extremely unsatisfactory. The results, however, which give as an average 0.375 gramme soda instead of 0.775 gramme, show that the mono-acid sodium phosphate is strongly alkaline, and the di-acid salt practically neutral, to rosolic acid. It is noteworthy that rosolic acid agrees in this respect with litmus, methyl-orange, and phenacetolin, but differs from phenol-phthalein, which indicates the mono-acid phosphate as the neutral salt; while normal sodium sulphite is neutral to both rosolic acid and phenol-phthalein, but strongly alkaline to litmus, methyl-orange, and phenacetolin.

(9.) *Effect of Silicate of Sodium.*—With rosolic acid as indicator the whole of the soda can be estimated by titration with standard sulphuric acid. This must be done in a boiling solution, as otherwise a good end-reaction is not obtainable. The tests were made side by side with experiments made on the same quantity of silicate of sodium, and using methyl-orange as indicator. The results were identical.

(10.) *Effect of Alumina.*—The solution employed for each experiment contained 0.775 gramme of available soda, and 0.103 gramme of alumina. In one titration 25.2 c.c., and in the other 25.25 c.c., of normal sulphuric acid were consumed, which show 0.781 and 0.782 gramme of soda respectively, instead of 0.775. Rosolic acid thus behaves in much the same way, and gives high results to the same extent, as litmus.

(11.) *Effect of Nitrite of Sodium.*—This salt is quite neutral to rosolic acid.

(12.) *Determination of Soda in Borax.*—Rosolic acid is not well fitted for use in this titration, as the end-reaction is extremely indistinct. A solution containing 1.683 grammes of baborate of sodium ($\text{Na}_2\text{B}_4\text{O}_7$), which is equal to 0.516 gramme of soda, was employed, but after the addition of 13.6 c.c. of normal sulphuric acid, the pink began to assume a yellow tint, and the former colour was not discharged till 16.6 c.c. had been consumed. This latter result gives 0.514 gramme of soda as against 0.516 actually present. I showed before that the best indicator for borax was methyl-orange, which gives a very well-defined end-reaction.

(13.) *Determination of Free Sulphuric, Nitric, Hydrochloric, and Oxalic Acids.*—Rosolic acid is an excellent indicator for use in the determination of these free acids, either by standard hydrate of sodium or potassium, the end-reaction in each case being extremely delicate.

(14.) *Determination of Free Tartaric Acid.*—For this purpose rosolic acid is certainly not so well adapted as phenol-phthalein, but the end-reaction is tolerably distinct, and fairly accurate results are obtainable.

(15.) *Determination of Free Acetic and Citric Acids.*—Rosolic acid is useless as an indicator in the determination of these acids, as, besides the end-reactions being very indefinite, normal acetate of sodium is slightly, and normal citrate of sodium considerably, alkaline to this indicator. In this respect rosolic acid resembles litmus, while the delicacy of phenol-phthalein, and the accuracy of the determinations made with it, are perfect.

It is plainly evident, on taking a survey of the above results, that rosolic acid has no particular superiority over other indicators, unless in some cases the fact of normal sulphite of sodium being neutral to it in cold solutions may be found useful. In nearly every case it behaves like litmus, and has none of the good qualities not possessed by the latter indicator, but which distinguish phenol-phthalein, methyl-orange, and phenacetolin.

Having now concluded the consideration of rosolic acid, I will give a few supplementary notes on the use of phenol-phthalein and methyl-orange as indicators.

(1.) *Determination of Free Citric and Acetic Acids.*—In the former portion of this paper phenol-phthalein was recommended as being the only perfect indicator for this purpose, but it was not mentioned that the titration should be done in the cold. The reason for this is that although the normal citrate and acetate of sodium are quite neutral to phenol-phthalein in the cold, yet when heated they give a slightly alkaline reaction (this is especially the case with the citrate), so that a sensibly high result would be obtained in a hot solution. Of course in the case of acetic acid, a hot solution dare not be used, unless excess of soda is first added, and then titrated back with acid.

(2.) *Phenol-phthalein as an Indicator in the Determination of Free Ammonia.*—This is a very important point to which special attention should be directed, particularly with the view of correcting some misleading statements that have been published respecting this indicator. I pointed out formerly that phenol-phthalein was incapable of showing at what point a solution containing a salt of ammonium was neutral, the reason being that such a salt had the effect of destroying the red colour produced by ammonia, even when the latter was present in considerable proportion. Phenol-phthalein has, however, been directly recommended as an indicator for ammonia by one author

and the mono-acid phosphates of sodium, potassium, and ammonium have been stated by another chemist to be neutral to it. This is true as regards the phosphates of sodium and potassium, but with the ammonium salt no definite neutral point is obtainable, owing to the de-colourising effect of the salt itself. The experiments made by these chemists have evidently been confined to potassium and sodium salts, while the behaviour of the ammonium salts have been simply assumed from these results. These facts show how incorrect statements may be made by trusting solely to the analogy between the salts of the alkali metals and ammonium.

(3.) *Valuation of Phosphate of Sodium or Potassium, and Phosphoric Acid.*—In the former portion of this paper I had occasion to describe the behaviour of normal ortho-phosphate of sodium and potassium when titrated with sulphuric acid, methyl-orange and phenol-phthalein being used respectively as indicators. The neutral point with methyl-orange is reached when the di-acid phosphate (NaH_2PO_4 or KH_2PO_4) is formed, while with phenol-phthalein the neutral salt is the mono-acid phosphate (Na_2HPO_4 or K_2HPO_4). On this definite difference of indication (which represents exactly one-third of the phosphoric acid present), I have ventured to base a process, which gives fairly accurate results, for the valuation of any of the ortho-phosphates of sodium or potassium, or of phosphoric acid. This is certainly a determination that is seldom required, but a rapid process of this description is at least of some interest, and may occasionally be found useful. The method consists in adding to 5 or 10 grammes of the sample, previously dissolved in about 80 c.c. of water, normal sulphuric acid from a burette till the faintly-acid reaction with methyl-orange is obtained, or in the case of phosphoric acid, normal caustic soda, added to the same point. The amount of acid or alkali added need not be measured, as the object is simply to add exactly enough to produce the di-acid phosphate. The mixture is now boiled for a short time to expel carbonic acid if present, then cooled (if the solution is kept hot a low result will be the consequence), a little phenol-phthalein added, and the titration accomplished by normal caustic soda or potash, 1 c.c. of which will represent 0.098 grammes of phosphoric acid (H_3PO_4) or 0.142 gramme of mono-acid sodium phosphate (Na_2HPO_4). Several tests were made of a sample of ordinary phosphate of soda, the results being controlled by two determinations by precipitation with magnesia mixture. The following were the results:—

By Alkalimetric Method.			By Pptn. as $\text{Mg}_2\text{P}_2\text{O}_7$.
Grammes of Phosphate of Soda tested.	C.c. of Normal NaHO consumed.	Percentage of Na_2HPO_4 .	Percentage of Na_2HPO_4 .
10	28.1	39.90	40.29
5	14.1	40.04	40.35
5	14.1	40.04	—

The theoretical percentage of dry phosphate of sodium in the crystallised compound is 39.66. It will be readily seen from the nature of the process that the presence of carbonate, sulphate, chloride, nitrate, thiosulphate, or sulphide of sodium or potassium will not influence the accuracy of the results. If sulphite of sodium is present it must first be oxidised to sulphate by the addition of a little peroxide of hydrogen (excess of which does not affect the delicacy of the indicators), as otherwise a high result would be obtained.

It will be observed that I have not noticed the application of phenol-phthalein as an indicator in the determination of caustic alkali in soaps, of free and combined fatty acids in oils and fats, and of resin acids, the reason being that this subject has been fully entered into by various chemists.

In conclusion, I may state that I am examining further the behaviour of phenol-phthaleins, methyl-orange, phenacetolin, rosolic acid, litmus, and other indicators with

other chemical compounds, having in view the special object of extending their employment, if possible, in the analyses of commercial chemical products.

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PYROLOGICAL NOTES.

By Lieut.-Col. W. A. ROSS, F.G.S., late R.A.

XII. ON A NEW PYROLOGICAL TEST FOR BORON TRIOXIDE.

"La détermination quantitative de l'acide borique présente de grandes difficultés." "Dans l'impossibilité d'obtenir un dosage direct, l'acide borique a été calculé d'après la perte." The well-known difficulty of quantitatively determining boron trioxide—of which the above quotations, taken respectively from the "Chimie Analytique" of H. Rosé (1862), which I believe still supersedes the work of Fresenius in France (vol. ii., p. 939), and from Des Cloizeaux's "Manuel de Minéralogie" (vol. i., p. 509), are the German and French expression—appertains in some degree to the pyrological qualitative determination by flame colouration; partly because you can obtain the precise shade of green from other substances, *e.g.*, from new, clean, platinum wire (*vide* my article "On a Green Beam," in *Knowledge* last year), and partly because the reaction is only momentary, and involves the use of reagents not, or little, required for any other purpose.

The so-called "Turner's test," by means of fluor-spar and acid potassium sulphate, was, in reality, devised by Prof. Arfvedson, and not by Dr. Turner, as I shall here show on the principle of "Honour where honour is due," although perhaps not precisely relevant to the subject.

Dr. Thomas Thomson, of Glasgow, says (page 164, "First Principles of Chemistry," 1825)—"I then became acquainted with M. Arfvedson's method of analysing the borates by means of fluor-spar. He mixes the borate to be analysed with a determinate quantity of fluor-spar reduced to the state of a very fine powder, and exposes the mixture with the requisite quantity of sulphuric acid to heat. . . . The boracic acid is disengaged in the state of fluo-boric acid, and the base of the borate remains combined with sulphuric acid." The various editions or Dr. Turner's work on Chemistry may now be purchased from any London old-book stall for a shilling, and a reference to it will show that he never mentions this test at all.

I will now detail the chemical and logical grounds upon which my proposed test is based.

In Plattner's celebrated "Blowpipe Tables," last edition, translated by Prof. Cornwall (1882), under the head of *Titanic Oxide*, we have the following statements:—(1) "With borax on platinum wire in R.F., a saturated glass becomes *enamel blue* by flaming." (2) "With salt of phosphorus on platinum wire in R.F., the glass assumes a fine violet colour on cooling." (3) "With soda in R.F. the glass, when perfectly cold, is greyish white to white." In these three experiments the soda and titanic acid are common to all, or constant quantities; the conditions of reaction are precisely similar in each case; the soda alone is evidently neutral as a colouring constituent; and we are therefore reduced to the two assumptions (a) that *boric acid* is the cause of the "*enamel blue*" colour afforded in the case of borax, and (b) that phosphoric acid is the cause of the "fine violet colour" in the case of salt of phosphorus.

Having thus far procured data for a plausible assumption or probability that even traces of boric acid would be indicated under certain pyrological conditions, by a *blue colour* when brought into contact with a large proportion of titanic acid before the blowpipe, for I had not only often produced Plattner's "*enamel blue*" with borax as above related, but had published the fact discovered by myself, that titanic acid affords yellow "*fragments*" in

pure boric acid, O.P., as a reagent, which *become blue in H.P.* (or R.F., see "Man. Bl. Anal." p. 7), my next step was to procure further confirmatory ground for this probability, or rather hope, before proceeding to practical experiment, as follows:—

I knew that the mineral *Warwickite* is essentially a boro-titanate of magnesium and iron, and it was not therefore without a little flutter of anxiety and hope that I looked in Dana's "System of Mineralogy" (1877) in order to see if such an accomplished analyst as Professor Brush should have produced a blue colour in his pyrological treatment of that mineral. After giving T. Sterry Hunt's analysis, " TiO_2 31.5, MgO 43.5, FeO 8.1, ign. 2.0, with a loss of 14.99 p.c., which Smith and Brush show to be boric acid," Prof. Brush details the ordinary blowpipe reactions, showing "with salt of phosphorus in O.F. . . . a clear bead, colourless on cooling" (no manganese), and adds, "with soda a *slight blue colour*," which he assumes to be due to a trace of manganese so small as to have escaped T. S. Hunt's analysis, and his own test with salt of phosphorus.

I now proceeded with my practical experiment by observing what colour sodium pyrotitanate (made by fusing titanate acid with soda B.B. on aluminium plate) would afford with a bead of "glacial phosphoric acid" coloured violet with titanium dioxide when treated in H.P. on charcoal. The colour was a reddish violet, pretty much the same as the bead. Let us call this reddish violet mass A.

I then dissolved as much powder of *Tourmaline* (from a Freiburg cabinet, and known to contain about 8 per cent of boron trioxide) as I possibly could in another phosphoric acid bead by H.P. on charcoal, so as to volatilise as little as possible of the B_2O_3 : we may term this saturated bead B. This done, I fused A and B together on charcoal in H.P., fondly hoping—nay, expecting—to produce at least a pale blue colour, but obtained only a grey opaque mass, which could not, even by its partial parent, be termed in the slightest degree, or by the exercise of any ingenuity,—"blue"! In sheer despair, and with some vague intention of separating constituents afterwards by "the wet way," I poured a few drops of distilled water over the mass in a little Berlin capsule, and left my "lab." in disgust.

Next day, still firm in the conviction that my premises, although for the present resulting in such "a lame and impotent conclusion," were sound and good, I returned to the laboratory, resolved to proceed towards the same end by a different series of experiments, and half sadly, half contemptuously, taking up the capsule containing my little abortion of the previous day, found, as much to my amazement as delight, the whole mass crystallised, and of a *pale, but very decided, blue colour*!

The secret was out. The blue titanium-borate of which I was in search had been (pyrologically) dissolved and concealed in the excess of sodium pyrophosphate, and only required to be "crystallised out" of its aqueous solution, to make it appear. That the colour cannot be due to any possible trace of manganese present (which is not detectable by treating the tourmaline powder alone with soda on Al plate O.P.) is proved by two facts—(a) The manganese would have shown itself by a blue tint in the dry solution by H.P. on charcoal; and (b)—This reaction requires the addition of water, with an aqueous crystallisation in order to succeed, which is not the case with any manganese pyrological reaction.

Most tourmalines are said to contain on the average from 3 to 9 per cent of boron trioxide.

I have now come to an end of my "Pyrological Notes" for the present, and if they have been so fortunate as to have attracted some of the many readers of the CHEMICAL NEWS to the subject, I can only hope that the latter have not been utterly disappointed by the perusal, but may have been even led—like the chemists Herr Pufahl, of Berlin, Herr Mylius, of Freiberg, and Herr Landauer, of Brunswick,—to try my new methods themselves.

NOTICE ON THE ATOMIC WEIGHTS.

By M. A. BUTLEROW.

THE remarkable observation of M. Schützenberger (*Bulletin de la Soc. Chimique*, xxxvii., p. 3), has decided the author to make the following communication. M. Schützenberger announced that in the analysis of certain hydrocarbons he had obtained figures which on calculation lead to a sum of carbon and of hydrogen distinctly greater than the weight of the substance submitted to combustion. Under other conditions these same bodies had yielded him normal results. The question is how to explain such an anomaly, admitting that there is no source of error in the analyses,—a supposition natural in the works of a chemist as skilful as M. Schützenberger? Evidently we can have recourse only to one of the three following hypotheses:—

1. Either the absolute quantity of the ponderable matter is increased; that something which we call force or energy being transformed into what, for us, is matter. We shall doubtless beware of making so hazardous a supposition in the present case, and I personally reject it, though without finding it in general absolutely impossible.

2. Or the absolute quantity of matter remaining the same, its weight has been augmented in consequence of a temporary increase of the intensity with which the substance in question gravitates towards the earth. Such a supposition, if more admissible than the former, seems to me scarcely probable.

3. Or lastly, it is not the weight of the matter which varies in any manner, but its chemical value undergoes a change. Indeed, if we admit that the atomic weight of carbon may descend temporarily to 11.8 (in place of 12, as generally admitted), all is explained. The capacity of saturation of the carbon having been increased by one-sixtieth, the quantity of carbonic acid formed with the same ponderable quantity of carbon will be greater. Instead of $12 + (16 \times 2) = 44$, this acid will be now $11.8 + (16 \times 2) = 43.8$, and we shall have about one-hundredth carbon in excess if setting out from *such* a carbonic acid (molecular weight 43.8) we calculate the weight of the carbon and take, as usual, the molecular weight 44, and the atomic weight of carbon = 12.

Is this last hypothesis admissible? In spite of the classical researches of M. Stas I cannot decide to regard it as utterly inadmissible, and I have even undertaken, with the aid of certain young chemists, a determination of some atomic weights under different conditions. I have taken occasion to explain my views briefly to the Russian Chemical Society (*Bulletin Soc. Chimique de Paris*, xxxvi., p. 303). I have undertaken experiments in order to determine comparatively the atomic weights of white and of red phosphorus. Circumstances and the very nature of these experiments having rendered the progress of these experiments very slow, we have also undertaken another series of a less laborious nature, *i.e.*, the determination of the quantity of mercuric chloride formed at the expense of a known quantity of the metal when it is combined directly with chlorine, allowing the latter to act either without the co-operation of light or with exposure to the light of the sun, or of the magnesium flame. Other influences, *e.g.*, that of the electric effluve, will also be brought into play. In most of these cases we propose to effect the determinations by the direct weight of the product formed. Without seeking to attain the extreme precision which characterises the experiments of M. Stas we hope to arrive at a relative decision as to the degree of constancy of the first decimal of the atomic weights.

Such researches, to me, do not appear devoid of all signification. The classical researches of M. Stas have established the absolute constancy of the atomic weights, of the composition and the chemical proportions of certain bodies, and under certain conditions; but it is not useless to establish this constancy under all imaginable conditions or to show that there exist influences which may cause

the atomic weights and the composition of bodies to vary within certain narrow limits. Whilst admitting the absolute constancy of the composition of chemical compounds M. Stas judged it necessary to study the influence of temperature upon the composition of silver chloride, as also that of temperature and pressure upon the composition of ammonium chloride from different sources. This composition was found constant under the conditions indicated, but that does not forbid the supposition that there may be other cases where such constancy does not exist.

The following considerations suggest doubts as to the absolute constancy of the atomic weights.

According to various precise researches, and especially to the incomparable investigations of M. Stas, we are forced to admit that the atomic weights are not expressed by whole numbers.

Yet, on the other hand, most of these weights approach so closely to whole numbers that it is quite impossible to regard these slight deviations as accidental, or to think that Prout's hypothesis is devoid of any serious foundation. At the same time we see in other cases that the numbers furnished by experiment, and upon which we depend in admitting the existence of the law, and for expressing it in a simple and rigorous form, approach more or less to the numbers required by the law, but without being identical.

Experimental results may ordinarily vary within certain limits, according to the conditions to which the body is submitted at the moment of the experiment. Such, *e.g.*, are the deviations found as regards the law of Boyle and Mariotte. As the gases deviate from this law, sometimes in one direction and sometimes in another, and as the magnitude of these deviations varies with the circumstances, we may admit that for each gas there exist conditions of temperature and pressure in which its accordance with the law is perfect. These conditions would be, so to speak, normal conditions with respect to the law of Boyle-Mariotte, and within their limits the law becomes rigorous and mathematically exact.

I therefore ask if the hypothesis of Prout may not become a truth under certain conditions which we cannot as yet precisely lay down? To raise this question is to deny the absolute constancy of the atomic weights, and I do not think that there is any necessity to admit such constancy. Let us set aside the atomic theory of the physicists as well as the atoms regarded as ultimate particles, absolutely indivisible.

What does the atomic weight of an element signify for the chemist? It represents merely a certain ponderable quantity of matter, the bearer of a determinate quantity of chemical energy. But we know well that for other forms of energy its quantity is far from being determined exclusively by the mass of matter. Quite the contrary, we see the mass remain the same and the quantity of energy increase. Why may not the same principle hold good for chemical energy, though within certain narrow limits?

At first sight it may seem strange to admit the possibility of a variation in the composition of a definite chemical compound. Carbonic acid, for instance, would then not be a compound containing absolutely 32 parts of oxygen to 12 parts of carbon (or rather 31.92 to 11.97); this acid would be a compound of carbon and oxygen in which the relative quantity of the constituents may vary, *e.g.*, in the limits of 12 : 32 to 11.8 : 32.

Would these varieties of carbonic acid still constitute one and the same chemical compound? I believe that they would, up to a certain point. There would, it is true, be no longer absolute unity, but the more general properties which we chiefly study, and especially the chemical properties, would remain the same. The properties of a compound are in fact merely the result of the reciprocal action of the elements which combine and mutually saturate each other. This state of saturation would remain without change in all cases, since the relative quantities of chemical energy acting on the part of each element would remain the same, in spite of any

change in the magnitude of the masses conveying this energy.

Such a supposition is perhaps hazardous, but is it entirely devoid of probability?—*Bulletin de la Soc. Chimique de Paris.*

BEHAVIOUR OF AMMONIUM SULPHIDE WITH THE METALS OF THE AMMONIUM SULPHIDE GROUP WHEN PRESENT IN SOLUTION AS DOUBLE PYROPHOSPHATES.

By G. BUCHNER.

If, to the solutions of the salts of manganous and man- ganic oxides, ferrous and ferric oxide, uranium oxide, nickelous and cobaltous oxides, zinc oxide, alumina and chromium oxide, there is added a solution of sodium pyrophosphate, there is formed a precipitate of insoluble pyrophosphates, which dissolve readily in an excess of sodium pyrophosphate; with the exception of the sparingly soluble chromium pyrophosphate these solutions behave differently with ammonium sulphide.

This reagent precipitates zinc, cobalt, nickel, and iron as sulphides, whilst manganese, uranium, chromium, and aluminium remain in solution. This solution, if heated or allowed to stand for some time, deposits manganese as a double pyrophosphate. On boiling, aluminium and chrome are deposited, whilst uranium remains in solution. —*Archiv. der Pharmacie und Chemiker Zeitung.*

DETERMINATION OF CAUSTIC ALKALIES IN PRESENCE OF ALKALINE CARBONATES, AND OF QUICKLIME IN PRESENCE OF CALCIUM CARBONATE.

By G. LUNGE.

THE author has examined a method first suggested by Degener. The solution of lime is coloured with phenacetolin, and normal acid is dropped in as long as the yellowness produced by each drop at once gives place to redness. If this change does not occur for a few seconds, the burette is read off, and two more drops of acid are added. If the liquid remains yellow the former reading was correct, but if it becomes red the addition of the acid must be continued until a permanent yellow colouration is established.

The determination of caustic soda is effected directly by titration with acid, using phenacetolin as indicator. As soon as the liquid remains of a faint rose colour all the sodium hydroxide is saturated, and only the carbonate remains. If more acid is added the yellowish red colouration changes suddenly to a golden yellow. At this point the carbonate also is saturated. The process is most suitable for caustic lyes which contain moderately large proportions of carbonate. Ammonia behaves differently from caustic soda, and is at once reddened by phenacetolin.

Dr. Lunge recommends practice with this indicator with liquids of known composition, so as to acquire a knowledge of the correct shade of colour.—*Zeitschrift Ver. Rubenz. Ind. und Chemiker Zeitung, Cöthen.*

Production of Bromised Apatites and Wagnerites. —A. Ditte.—The apatites and wagnerites form a numerous series of compounds, such that to each term of the series containing chlorine there corresponds another, the composition and general properties of which are the same, but containing bromine.—*Comptes Rendus.*

NOTICES OF BOOKS.

An Introduction to the Study of Organic Chemistry. By ADOLPH PINNER, Ph.D., Professor of Chemistry in the University of Berlin. Translated and Revised from the Fifth German Edition by PETER T. AUSTEN, Ph.D., F.C.S., Professor of Analytical and Applied Chemistry in Rutgers College and the New Jersey State Scientific School. New York: John Wiley and Son. London: Trübner and Co. 1883.

THE multiplicity of books on chemistry that have appeared during the last few years, both original and translations, would seem to afford the most fastidious student of the science a superabundant field from which to select his mental pabulum; still, in spite of all the contributions to chemical literature in the way of text-books, creditable and otherwise, we have here another addition to the stock treating of the carbon compounds.

This work, an American translation, coming as it does from the home of organic research, raised our expectations of getting something really good, especially as the translator tells us in his preface that it "is founded on the system of teaching developed by the distinguished chemist Prof. A. W. Hofmann, of Berlin, and in some cases follows his lectures quite closely." And, again,—“In translating Prof. Pinner's book, I have preserved as far as possible the easy lecture style which is characteristic of it, and have not hesitated to employ numerous expressions which have come into use in working laboratories, and which recommend themselves for brevity and clearness.” An examination of the arrangement of the contents, however, did not fulfil the expectations we had formed of the book. That the fault lies in the classification that has been adopted is evident, as it has involved the indiscriminate heaping together of formulæ innumerable, with little, if any, attempt being made to bring out the symmetrical beauties that prevail in organic chemistry.

After a short introduction, in which the tetra-valency of carbon is explained, and the possibility of isomers due to alteration in the radicles and change of position, the author begins with the methane compounds, the halogen, nitrogen, and other substitution-products being described, and what seems greatly out of place in an elementary text-book, the compound ureas, and the phosphorus, arsenic, and antimony derivatives. In this way the work proceeds until hexane is reached. The aromatic compounds are treated in a somewhat similar manner, commencing with a short account of the benzene nucleus, and an explanation of the ortho, meta, and para positions. The last portions of the book are devoted to the alkaloids, glucosides, bitter principles, biliary and protein substances; and as an appendix, the quantitative methods for the ultimate analysis of organic compounds are given, also a clear, but too short, outline of the methods employed for determining the constitution of organic bodies. This latter, we think, might have been extended with profit.

Some of the terms that are introduced do not seem to us to be improvements, as, for instance, “esters” for the compound ethers, methylic formate being termed formic methyl ester, and the word “rest” where radicle might do. The language employed in some parts of the book would require a little preliminary explanation to help the understanding. For example—“It is not remarkable, therefore, that in the group CH_3 an unsatisfied bond, or valence, is free and active, and can only be rendered inactive by an equally great energy. It makes no difference if this energy is the entire attractive power of a single atom of a mono-valent element, or the remainder of all the active attractive energies of an atomic group so long as its amount is equal to one.”—(Page 8.) Again, in the account of certain reactions the language is frequently very lax, as ammoniac formate by rapid heating “falls into cyanhydric acid and water,” and methylic iodide acts on phosphonium iodide, hydriodic acid being “split off;”

also, “Ethylene in the presence of platinum-black unites with hydrogen to ethane;” and, for the sake of brevity we presume, the student is taught that three H's combine with one N, and so on.

The preface says that “The intention has been to make this book not a dictionary of compounds—but a text-book which can be placed in the hands of college students.” From our perusal of the work, however, formulæ seem to monopolise the greater part of it, and the reasonings by which the constitution of many important compounds is evolved, left as a puzzle to the enquiring mind. This, we think, might well replace much of the needless symbolism so frequently pressed into works on organic chemistry, and might act as savouring to such dry bones.

“It is believed that a student who has carefully studied and faithfully recited this book will be able to take up understandingly the larger works,” and, we might add, even make some little progress in empiric research, but we fear that the student's appreciation of the order and symmetry existing in organic chemistry will not be benefitted to any great extent.

The Gas Manager's Handbook. By THOMAS NEWBIGGING, M. Inst. C.E. Third Edition. London: Walter King. 1883.

THE information contained in this little book, which is of a thoroughly practical kind, is eminently suited for the use of managers and engineers actively engaged in the gas-lighting industry. The contents are arranged in brief paragraph form, as being the most convenient for reference, and no pains seem to have been spared in culling from all sources innumerable facts and tables that may be of practical service.

Commencing with lengthy tables containing the analytical results obtained from the chief coals employed for gas-making purposes, their yield of coke and gas, and the illuminating powers of the latter, the author passes to retorts, condensers, scrubbers, and other appurtenances that form the plant of a gas-works, giving the dimensions and modes of arrangement found in general use. The purification of coal-gas is pretty fully described, and the methods adopted for the estimation of the several deleterious constituents, but we think that the explanation given of Harcourt's test for carbon disulphide and sulphuretted hydrogen might be made more intelligible, even at the expense of a little theory, and the sketch showing the arrangement of the apparatus lettered.

The corrections to be applied for variations in pressure and temperature, meters, and the plans adopted for computing the illuminating power of coal-gas, are described; at some length, a few numerical examples being introduced to show the application of the rules laid down.

In the table of elementary bodies we notice beryllium with an atomic weight of 9.4 and glucinum 9.3, thus giving to the same element two different values; also that the formulæ attached to several of the compounds formed by the destructive distillation of coal are not in harmony with the atomic weights given, as C_2N for cyanogen, and NO_3 for nitric acid. It is a pity also that the only example we notice of the application of atomic weights and formulæ to the calculation of the constituents of a compound is wrong owing to the author taking 6 for the equivalent of carbon in C_2H_4 , so that “12 grains, or 12 ozs., or 12 lbs. of carbon combine with 4 grains, or 4 ozs., or 4 lbs. of hydrogen to form 16 grains, or 16 ozs., or 16 lbs. of olefiant gas.”—(Page 296.)

It is to be regretted that a little space has not been given to the chemistry of destructive distillation; even the merest outline would be of service to the most thoroughly practical manager, and would form a fair substitute for the tables of “squares” and “cubes” appended to the work. In spite of the few errors we have noticed in this handbook, we feel assured that it will be of no little service to gas-engineers, managers, and others engaged in the manufacture and distribution of coal-gas.

Englisches Conversations-Buch für Pharmaceuten. (English Conversation-Book for Pharmaceutists.) By Dr. Th. D. BARRY. Berlin: Julius Springer. 1883.

It is evidently a misnomer to entitle this little work a conversation-book, as of the fifty pages of which it consists only five are devoted to dialogues. This, however, does not detract from its value, as the arrangement and nature of the contents, which consist of vocabularies of pharmaceutical words and phrases, are in a more suitable form than if thrown into dialogues. The book is divided into eleven sections, the first six of which contain words and phrases in daily use among pharmacutists, the English and German synonyms being arranged in each language alphabetically under various headings, such as drugs, instruments and apparatus, anatomy and diseases. The seventh section gives the German equivalents of the Latin contractions which are employed to adorn prescriptions. The eighth and ninth show the relations of the weights and measures of the British Pharmacopœia to those of the decimal system, gramme, and litre, whilst the tenth section contains a few specimens of short letters.

To the English pharmacist having any dealings with German patients we have no doubt that this little work of Dr. Barry's will be found of some service, supplemented with a little colloquial knowledge, especially as many of the phrases are not usually found in ordinary dictionaries.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

Ordinary General Meeting, Thursday, April 12, 1883.

Mr. WILLOUGHBY SMITH, President, in the Chair.

AN elaborate paper on "*Microphonic Contacts*," by SHELFORD BIDWELL, was first read, after which a "*Note on the Influence of Surface-condensed Gas upon the Action of the Microphone*," by I. PROBERT and ALFRED W. SOWARD, was read by the SECRETARY. The authors have studied the influence upon the action of the microphone of the layer of condensed gas with which the carbon surfaces are coated. In the case of two gases condensable without liquefaction, the better microphonic effect was obtained with the less condensable gas; in the case of two condensable with liquefaction, the better effect was obtained with the gas which in the liquid state is the better electrical conductor.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

March 19, 1883.

MR. ROBERT R. TATLOCK, F.C.S., President, in the Chair.

THE usual preliminary business having been disposed of, Dr. CLARK read a paper "*On a Volumetric Process for the Estimation of Nickel and Cobalt*."

Mr. ROBERT T. THOMSON read a paper "*On the Use of Rosolic Acid as an Indicator*." (See p. 184.)

Researches on the Crystalline Phosphates.—MM. Hautefeuille and Margottet.—The authors have obtained a number of phosphates in crystals by using as solvents certain salts in igneous fusion. They dissolve the amorphous phosphates obtained by precipitation in about 4 parts of melted metaphosphoric acid.—*Comptes Rendus*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 13, March 26, 1883.

Note on the Preparation of Cerium Oxide.—H. Debray.

Observation on the Figures given for the Consumption of Zinc by M. G. Trouvé for his Bichromate Battery.—The author points out that the consumption of zinc given by M. Trouvé in his recent memoir is less than what would be required by theory. It is therefore desirable that his experiments should be repeated.

Formation-heat of the Glycolates.—M. de Forcrand.—It is not difficult to predict approximately the combination-heat of any acid with a given base in a state of solution. It is sufficient to be guided by a law well known in science, according to which all acids when combining with one and the same base disengage the same quantity of heat. Hence the difference of the neutralisation-heats for two bases or oxides is almost constant. Such is the law of Andrews, which dates back to 1842. If we add to the neutralisation-heat the oxidation-heat of the metal, we have the table of modules of Favre and Silbermann, which is more than thirty years old.

Action of Sulphur upon Oxides.—MM. E. Filhol and Senderens.—A thermo-chemical paper, in which the authors study the action of sulphur upon potassa and soda, both in the solid state and in solutions more or less dilute.

The Action of Different Varieties of Silica upon Lime Water.—E. Landrin.—The author has examined comparatively four varieties of silica: hydraulic silica, gelatinous silica, Graham's soluble silica, and the silica of hydro-fluosilicic acid. He concludes that hydraulic silica, gelatinous silica, and soluble silica absorb lime water more or less rapidly, but that in all cases the absorption varies finally between the limits 36 and 38 per equiv. of silica.

The Type-Hydrate of Neutral Aluminium Sulphate.—P. Margueritte-Delacharlonny.—According to the author the typical hydrate contains not 18 but 16 mols. water; that it does not attract moisture from the air, but rather tends to effloresce, and that it may be obtained in definite crystals, i.e., ortho-rhombic prisms much flattened.

Effects Produced by Air upon Beer Yeast.—D. Cochin.—The air appears to attenuate the ferments as it does the virus of zymotic diseases.

Determination of the Extractive Matters and of the Reducing-power of Urine.—MM. Etard and C. Richet.—The authors remark that in ordinary analyses of urine the urea alone is determined, though it forms only 75 per cent of the organic matter present. For the determination of the other matters they have devised a process based upon the action of bromine upon urine in acid and in alkaline solutions respectively. In an acid solution bromine attacks neither urea, creatine, creatinine, hippuric acid, nor xanthine, but merely uric acid and the so-called extractive matters. In an alkaline solution it acts upon all the above-mentioned substances. The authors promise to give the details of their process on a future occasion.

Cosmos Les Mondes.

No. 12, March 24, 1883.

Combination-Heats of the Soluble Compounds of Strontium.—Dr. D. Tommasi.—The author shows in parallel columns the combination-heats of the soluble

compounds of strontium, as found experimentally, and as calculated in accordance with the law of thermic substitution-compounds, the correspondence being very close.

Journal de Pharmacie et de Chimie.

Tome v., April, 1883.

Contributions to the History of the Reactions between Sulphur, Carbon, their Oxides and their Salts.—M. Berthelot.—Already noticed.

Plumbiferous Tinning of Preserved Meats.—P. Carles.—When tinned iron serves for containing alimentary matters it is essential that the tin employed should be free from lead. The latter metal is rapidly oxidised on the surface and is dissolved in this form in the neutral acids of vegetables, meat, &c. The most exact method of demonstrating the presence of lead consists in treating the alloy—so-called tin—with *aqua regia* containing relatively little nitric acid. The whole dissolves; the excess of acid is driven off by evaporation at a boiling heat, and the residue, diluted with water, is saturated with hydrogen sulphide. The iron remains in solution, whilst the mixed lead and tin sulphides precipitated are allowed to digest for a long time in an alkaline sulphide. The tin sulphide only dissolves; it is filtered off and converted into stannic acid, whilst the lead sulphide is transformed into sulphate and weighed as such.

Toxicological Search for Blood.—C. Husson.—The author describes a case where certain stains on the blouse of a man suspected of murder were proved by the size of the globules to be due to the blood of a rabbit. Certain stains on his shirt which had seemed suspicious had been derived from the dye of his clothing modified by the action of rain and sweat.

Effects of the Respiration of Air charged with Vapours of Petroleum.—M. Poincaré.—The author has kept dogs, rabbits, and guinea pigs in atmospheres resembling those to which persons working with petroleum are exposed. The guinea pigs alone succumbed after remaining from one to two years in this medium. The other animals seemed to resist indefinitely. He nevertheless recommends persons employing petroleum as a source of heat and light or who treat it industrially to keep their stock in closed vessels, to attend to ventilation, and to execute the operations of rectification, &c., under draught-hoods.

Note on the Assay of Quinine Sulphate.—H. Byasson.—The author recommends a polarimetric process, based on the fact that for a neutral quinine sulphate the deviation is $-23^{\circ}3'$; for the cinchonidine salt, $-16^{\circ}5'$; for quinine, $+26^{\circ}4'$; and for cinchonine sulphate, $+22^{\circ}2'$. The process of Kerner he considers unsatisfactory, as it may cause samples of quinine sulphate containing mannite, gum, salicine, calcium phosphate to be pronounced good.

Memoir on Sprouted Wheats.—M. Ballard.—Not adapted for useful abstraction.

Physiological Action of Sodium Borate: Its Elimination by Saliva and Urine; its Action in Medicine and Odontology; its Pharmaceutical Preparations.—F. Vigier.—The title of this memoir will be a sufficient notice.

Poisonous Properties of the Morel (*Morchella esculenta*).—M. Ponfick.—The author has discovered in these fungi a very energetic poisonous principle, and shows that their safety or danger depends on the method of preparation. The poisonous matter is eliminated by repeated treatments with boiling water, or may be destroyed by prolonged desiccation. The poisonous compound, probably an alkaloid, acts by disorganising the blood-globules.

Action of Carbonic Oxide upon Plants.—L. Just.—The author finds that carbon monoxide is not assimilated by plants, and that in proportions exceeding 1-20th per cent it is injurious.

MISCELLANEOUS.

London Chamber of Commerce: Chemical Trades Section.—The following circular has recently been sent out in view of the formation of a Chemical Trade Section of the Chamber:—"It is proposed to form a chemical section of the London Chamber of Commerce. This would tend greatly to strengthen the hands of all engaged in the various branches of chemical industry in London, giving them more power to influence legislation in favour of their own interests, and enabling them to take a united stand against any action, either individual or corporate, which they consider inimical, as well as adjusting any points of difference which may exist between the various branches themselves. The absence of any joint association of this kind has been most detrimental to us, each and all, in the past, as you will doubtless admit. Now, by means of such a special Chemical Trades Section as I suggest, we shall be not only able to discuss our requirements, but to enlist in favour of our decisions and resolutions the influence and powers of legislative action possessed by the London Chamber. The action of the Chamber in the general interests of the commerce of London is too diffuse and well known to particularise in this letter, but in such matters as the establishment of Courts of Arbitration, under proper laws and control, the alteration of the existing Bankruptcy Act, &c., it will, I am sure, elicit your approval. I have been requested by the Council (of which I am a nominated member) to aid in this project, which, together with the great importance of the subject, I plead as my excuse for thus troubling you. Will you then aid this endeavour by becoming an annual subscriber to, and member of, the London Chamber (subscription £1 rs. as individual, or £2 2s. as a firm), and also help in the formation of the section with your advice, &c. If you are willing to join, kindly fill in the accompanying form, and return it to the Secretary of the Chamber at the above address, and I will see that it is put before the Council immediately, with a view to your election.--T. FARMER HALL."

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Gas Purification.—(Reply to R. H.)—Dr. Versmann took out a patent for purification of gas by means of a preparation of tungsten. This is very effective, and can be used economically in the laboratory. On the small scale the gas is passed through a heated tube containing asbestos that has been treated with tungsten or platinum; a low red heat is sufficient to decompose the CS_2 , the resulting H_2S can be removed in the ordinary way. The illuminating power of the gas is improved.—LEO TAYLOR, F.C.S.

MEETINGS FOR THE WEEK.

- MONDAY, April 23.—Medical, 8.30.
TUESDAY, 24th.—Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8.30.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
WEDNESDAY, 25th.—Society of Arts, 8.
— Geological, 8.
— London Institution, 12. (Anniversary).
THURSDAY, 26th.—Royal Institution, 3. "Art of Pheidias," by Dr. Waldstein.
— Royal, 4.30.
FRIDAY, 27th.—Royal Institution, 8. "Solar Physics," by Mr. C. W. Siemens, at 9.
— Quekett Club, 8.
SATURDAY, 28th.—Royal Institution, 3. "Geographical Evolution," by Mr. A. Geikie.
— Physical, 3. "A New Photometer," by Sir John Conroy. "Colour Sensations," by H. R. Droop. "Causes and Consequences of Glacier Motion," by Walter R. Browne. "Measurement of Radiant Energy," by Capt. Abney, F.R.S.

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THE CHEMICAL NEWS.

VOL. XLVII. No. 1222.

ON THE LIQUEFACTION OF OXYGEN AND NITROGEN, AND THE SOLIDIFICATION OF SULPHIDE OF CARBON AND ALCOHOL.*

By S. WROBLEWSKI and K. OLSZEWSKI.

THE following despatch was addressed in the first place by M. Wroblewski to M. Debray on April 9.

"Oxygen liquefied; completely liquid; colourless, like carbonic acid. You will receive a note in a few days."

The note M. Debray has since received, and it reads as follows:—

"The beautiful investigations of MM. Cailletet and Raoul Pictet on the liquefaction of gases permitted the hope that some day chemists would be able to observe oxygen reduced to the liquid state in glass tubes, as is done at present in the case of carbonic acid; the condition being solely to obtain a sufficiently low temperature. M. Cailletet, in a note published a year ago,† recommended liquefied ethylene as a means for obtaining very intense cold. This liquid *under the pressure of one atmosphere*, boils at -105°C . if a sulphide of carbon thermometer is employed to measure the temperature. Having compressed oxygen in a capillary tube and cooled in this liquid to -105°C ., M. Cailletet observed at the moment the pressure was released, 'a tumultuous ebullition, persisting for an appreciable time and resembling the projection of a liquid in the cooled part of the tube. This ebullition forms at a certain distance from the bottom of the tube. I have not been able to recognise,' adds M. Cailletet, 'if this liquid pre-exists, or if it is formed on releasing the pressure, for I have not yet been able to see the plane of separation between the gas and the liquid.'

"Profiting by a new apparatus constructed by one of us (Wroblewski), which allows the placing of relatively large quantities of gas under pressures of some hundred atmospheres, we proposed to ourselves to study the temperature of gases during the detent. These experiments have soon led us to the discovery of a temperature at which sulphide of carbon and alcohol freeze, and at which oxygen liquefies completely with great facility. This temperature is obtained by allowing ethylene to boil in a vacuum. The temperature depending on the degree of the vacuum obtained, the minimum we have been able to obtain till now is -136°C . We have determined this temperature, like all the others, with a hydrogen thermometer.

"The critical temperature of oxygen is lower than that at which ethylene boils under atmospheric pressure. This latter is not -105°C ., as has been admitted till the present time, but it lies between -102° and 103°C ., as we have found with our thermometers.

"From a series of experiments which we have made on April 9, we give the following numbers as an example:—

Temperature.	Pressure in Atmospheres under which Oxygen commenced to Liquefy.
131.6	26.5
133.4	24.8
135.8	22.5

"In publishing these numbers we reserve for our next note the communication of definite values.

"Liquid oxygen is colourless and transparent, like carbonic acid. It is very mobile, and forms a sharp meniscus.

"As to sulphide of carbon it freezes at about -116°C ., and melts at about -110°C .

"Alcohol becomes viscous, like oil, about -129°C ., solidifying about -130.5°C ., forming a white body."*

On April 10, another despatch was sent by M. Wroblewski:—

"Nitrogen cooled, liquefied by detent; meniscus visible, liquid colourless."

MEASUREMENTS OF THE WAVE-LENGTHS OF RAYS OF HIGH REFRACTIBILITY IN THE SPECTRA OF ELEMENTARY SUBSTANCES.†

By W. N. HARTLEY, F.R.S.E., &c., Professor of Chemistry,
Royal College of Science, Dublin, and
W. E. ADENEY, F.C.S., Associate of the Royal College of Science.

THE authors describe a method of taking photographs of diffraction spectra produced by a small Rutherford speculum ruled with 17,460 lines to the inch. The lines in the spectra were accurately measured by the aid of a microscope magnifying 25 diameters and a dividing engine.

The length of the spectra which were taken on three different plates was 14 to 15 inches, and the measurements were accurate to the $\frac{1}{25000}$ th of an inch. From these measurements the wave-lengths of the lines were calculated. The spectra include lines with wave-lengths 4674 and 2024. They were produced by electric sparks condensed by a pane of glass coated with tin-foil.

Of the electrodes used *one always* consisted of cadmium, the other of the metal or the solution of the metal, or other elementary substance, the wave-lengths of the lines of which was to be determined; thus all the spectra were referable to the cadmium lines. Great accuracy is attainable by this method, and lines which have appeared identical or coincident in two different spectra have thus been proved to differ in refrangibility.

All the spectra were compared with spectra obtained with the prism spectroscope described by one of the authors in the *Scientific Proceedings of the Royal Dublin Society*, vol. iii., Part III., April, 1881.

Great care was exercised in taking the photographs, lest any irregularity in the surface of the plates should lead to inaccurate measurements. Gelatin films on specially selected *patent plate* glass were used, and such a precaution is quite necessary. The photographs were not varnished. A certain number of lines measured by previous observers have been compared with the new measurements. Taking the numbers given by Thalén, Lecoq de Boisbaudran, and Cornu for 150 lines in the spectra of magnesium, zinc, cadmium, aluminium, indium, thallium, iron, &c., a close agreement with their measurements affords satisfactory evidence of the accuracy of these determinations. Besides the wave-length, a very careful description of the appearance of each line is given, together with its linear measurement indicating its position on a series of photographs obtained with the prism spectroscope, which series of photographs is presented with the paper. A distinction is drawn between those lines determined directly with the grating and others too faint to be seen on diffraction photographs, which were measured by the aid of the prism spectroscope and an interpolation curve $9\frac{1}{2}$ metres in length. The total number of lines measured and described is 2247, namely:—Magnesium, 42; zinc, 151; cadmium, 141; aluminium, 30; indium, 104; thallium, 70; copper, 164; silver, 124; mercury, 80; carbon, 20; tin, 129; lead, 86; tellurium,

* *Comptes Rendus*, t. xcvi., p. 1140.

† *Ibid.*, t. xciv., pp. 1224–1226.

* These experiments were made in the laboratory of M. Wroblewski, at Cracow.

† Abstract of a Paper read before the Royal Society, April 19, 1883.

322; arsenic, 112; antimony, 211; bismuth, 156; air, 215; and iron, 150.

A series of eighteen enlarged photographs, 36 inches in length, are presented with the paper, on which each line has its wave-length written over it.

ELECTRIC LIGHTING.

RULES AND REGULATIONS FOR THE PREVENTION OF FIRE RISKS ARISING FROM ELECTRIC LIGHTING.*

THESE rules and regulations are drawn up for the reduction to a minimum, in the case of electric lighting, of those risks of fire which are inherent in every system of artificial illumination, and also for the guidance and instruction of those who have, or who contemplate having, electric lighting apparatus installed in their premises.

The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing," or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the dangerous production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are either ordinarily or for the purpose of testing, passed through the circuit. Should wires become perceptibly warmed by the ordinary current, it is an indication that they are too small for the work they have to do, and that they should be replaced by larger wires. Bare or exposed conductors should always be within visual inspection, and as far out of reach as possible, since the accidental falling on to, or the thoughtless placing of other conducting bodies upon such conductors would lead to "short circuiting," and the consequent sudden generation of heat due to an increased current in conductors not adapted to carry it with safety.

The necessity cannot be too strongly urged for guarding against the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger.

The chief dangers of every new application of electricity arise from ignorance and inexperience on the part of those who supply and fit up the requisite plant.

The greatest element of safety is therefore the employment of skilled and experienced electricians to supervise the work.

I. The Dynamo-Machine.

1. The dynamo-machine should be fixed in a dry place.
2. It should not be exposed to dust or flyings.
3. It should be kept perfectly clean and its bearings well oiled.
4. The insulation of its coils and conductors should be practically perfect.
5. All conductors in the Dynamo-Room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

* Recommended by the Council of the Society of Telegraph Engineers and of Electricians in accordance with the Report of the Committee appointed by them on May 11, 1882, to consider the subject. Members of the Committee.—Professor W. G. Adams, F.R.S., Vice-President; Sir Charles T. Bright; T. Russell Crompton; R. E. Crompton; W. Crookes, F.R.S.; Warren De la Rue, D.C.L., F.R.S.; Professor G. C. Foster, F.R.S., Past President; Edward Graves; J. E. H. Gordon; Dr. J. Hopkinson, F.R.S.; Professor D. E. Hughes, F.R.S., Vice-President; W. H. Preece, F.R.S., Past President; Alexander Siemens; C. E. Spagnoletti, Vice-President; James N. Shoolbred; Augustus Stroh; Sir William Thomson, F.R.S., Past President; Lieut.-Colonel C. E. Webber, R.E., Past President.

II. The Wires.

6. Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left it cannot permit of a permanent arc or of heating.

7. Every part of the circuit should be so determined, that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and all junctions with a smaller conductor should be fitted with a suitable safety fuse or protector, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150° F.

8. Under ordinary circumstances complete metallic circuits should be used; the employment of gas or water pipes as conductors for the purpose of completing the circuit should not in any case be allowed.

9. Bare wires passing over the tops of houses should never be less than 7 feet clear of any part of the roof, and all wires crossing thoroughfares should invariably be high enough to allow fire escapes to pass under them.

10. It is most essential that joints should be electrically and mechanically perfect and united by solder.

11. The position of wires when underground should be clearly indicated, and they should be laid down so as to be easily inspected and repaired.

12. All wires used for indoor purposes should be efficiently insulated, either by being covered throughout with some insulating medium, or, if bare, by resting on insulated supports.

13. When these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses, like iron girders or pipes, they should be thoroughly protected by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be efficiently encased in some hard material.

14. Where indoor wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the apparatus and circuits cannot be too strongly urged. The escape of electricity cannot be detected by the sense of smell, as can gas; but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering, by electric action.

III. Lamps.

15. Arc lamps should always be guarded by proper lanterns to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. Their globes should be protected with wire netting.

16. The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV. Danger to Person.

17. Where bare wire out of doors rests on insulating supports, it should be coated with insulating material, such as india-rubber tape or tube, for at least 2 feet on each side of the support.

18. To secure persons from danger inside buildings, it is essential so to arrange and protect the conductors and fittings, that no one can be exposed to the shocks of alternating currents of a mean electromotive force exceeding 100 volts, or to continuous currents of 200 volts.

19. If the difference of potential within any house exceeds 200 volts, the house should be provided with a "switch," so arranged that the supply of electricity can be at once cut off.

By Order of the Council.

F. H. WEBB, Secretary.

Offices of the Society,
4, The Sanctuary, Westminster,
April 11, 1883.

ON SOME
THEORETICAL CONSIDERATIONS CONNECTED
WITH THE HARDENING AND TEMPERING
OF STEEL.

By Professor CHANDLER ROBERTS, F.R.S.

THE Cutlers' Company of London have, during the past few years, instituted a series of lectures in connection with the general scheme for technical education. The last of the series for the present session was delivered on Thursday, April 12, by Prof. Chandler Roberts, F.R.S., "On some Theoretical Considerations connected with the Hardening and Tempering of Steel."

He traced the history of the subject, and, quoting Guyton Morveau, said that Stahl, the great supporter of the Phlogistic theory, considered that iron, "cemented" with carbon in closed vessels, gained phlogiston, and became in consequence steel; and this was the opinion of his disciples, who considered steel to be merely iron possessing the characteristics of a metal in a higher degree than iron, a view which will be found in the works of Henckel, Cramer, Gellert, Rinman, and Maquer. Bergmann (1781), to whom we owe the discovery of the fact that the presence or absence of graphite makes all the difference in the properties of wrought-iron, steel, and cast-iron, retained the phlogistic theory generally, although he considered that steel contains less phlogiston than wrought-iron. Professor Roberts pointed out that we are still repeating Bergman's question "How does the graphite act" in producing the singular difference between hard and soft steel. The early experimenters who followed Bergman knew the importance of establishing the action of carbon in converting iron into steel, and Clouet, in 1796, followed by others in this country, converted soft iron into steel by heating it with the diamond. In these early experiments furnace gases had not been excluded, and it was urged that they might have converted the iron into steel without the intervention of the diamond. A past master of the Company of Cutlers, Mr. W. Haseltine Pepys, repeated, in 1815, Clouet's experiment, under conditions which left no doubt as to the action of the diamond, for he employed electricity as a source of heat, and thus avoided the action of furnace gases altogether.

It was then shown that in soft, tempered, and hardened steel respectively, the carbon has a "distinct mode of existence," and the evidence as to whether carbon in steel is combined in the chemical sense, or is merely dissolved, was considered at length. The chemical evidence given by Berzelius, Karsten, Gurlt, Forquignon, and recently by Sir F. Abel, the distinguished chemist of the War Department, was then reviewed. With regard to the "solution" theory held by Vandermonde, Berthollet, and Monge in 1786, there is the recent and important calorimetric work of Troost and Hautefeuille, who showed that in white cast-iron, and probably in steel, the carbon is merely dissolved, a view which the lecturer adopted, as he did not consider it to be in any way in opposition to the fact established by Abel, that the carbon left by the slow action of a chromic acid solution is in the form of a definite carbide.

The various physical, as distinguished from the chemical, theories which had been set forth from the time of Réaumur, 1722, to that of Akerman, 1879, to account for the "intimacy of the relation" of carbon to iron in hardened as compared with soft steel, were then described. In recent years much importance had been attached to the physical evidence as to the peculiar constitution of steel, and it had been shown that there is a remarkable relation between the amount of carbon contained in different varieties of steel and their electrical resistance. The latest work, however, in this direction has been done by Prof. Hughes, and his very interesting experiments on the effect of torsion on wires of wrought-iron, soft and

hard steel, through which a current is passed, was then described. The effect of hardening in oil on the tensile strength of steel of different degrees of carburization was then shown by the aid of curves, and it was incidentally pointed out that in the case of the variety of steel used for the manufacture of coinage dies a variation of 1-10th per cent of carbon makes a great difference in the quality of the metal.

NOTE ON WATER ANALYSIS.

By LEROY W. McCAY, M.A., D.Sc.

In estimating the organic purity of waters here in Princeton we have been accustomed to check the ammonia process of Wanklyn by the permanganate method of Dr. Tidy. Great difficulty, however, has always been experienced in hitting upon the precise moment at which the blue colour of the iodised starch disappears. In order to avoid this uncertainty and annoyance, and at the same time to escape the loss of time and trouble incident to a re-addition of permanganate, Prof. Cornwall suggested the use of protosulphate of iron. The suggestion appeared all the more worthy of consideration, inasmuch as both Kubel and Wanklyn, the former in his method for estimating nitrites in drinking waters, the latter in his so-called moist-combustion process, make use of ammonium ferrous sulphate as an auxiliary in the determination of the amount of permanganate reduced or of oxygen consumed, and, in consequence thereof, I at once set to work and made up a solution of the double salt, which I have found to work most admirably. The strengths of my solutions are as follows:—

0.395 grm. potassic permanganate in 1000 c.c. pure water.

4.900 grm. ammonium ferrous sulphate in 1000 c.c. pure water.

To keep the solution of the double salt clear it will be found to be well to substitute for 25 c.c. of the pure water 25 c.c. of concentrated sulphuric acid.

I have, by repeated and numerous experiments, assured myself that not only are the results constant, but that their agreement with the figures obtained by the use of Dr. Tidy's hyposulphite, potassic iodide, and starch method are all that could be desired. The following figures will serve to indicate the degree of agreement between the results as obtained by each method:—

		Hyposulphite.		Ammonium ferrous sulphate.
1.	..	0.351	..	0.365
2.	..	0.092	..	0.086
3.	..	0.050	..	0.050
4.	..	0.030	..	0.036
5.	..	0.038	..	0.032
6.	..	0.023	..	0.028
7.	..	0.090	..	0.096
8.	..	0.030	..	0.020

When we take into consideration the fact that a water consuming 0.05 grm. oxygen per 100,000 c.c. may be regarded as excellent, and, moreover, that a difference in reading of 0.25 c.c. on the chameleon burette will occasion a difference of 0.01 grm. oxygen, I think that all will agree with me in concluding that the above figures are satisfactory, and that the ammonium ferrous sulphate method is as delicate and exact as that of Dr. Tidy's, involving the use of the hyposulphite, potassic iodide, and starch.

By making use of the double salt: 1. The uncertainty connected with the precise moment of disappearance of the blue of the iodised starch is avoided. 2. A considerable amount of time is saved. 3. Two solutions alone are requisite for making an estimation; and 4. The amount of chemically pure water is reduced to a minimum.

The ammonium ferrous sulphate solution keeps remarkably well. In two weeks I have been unable to detect a trace of change. I keep my solution in a large green bottle and in the dark.

John C. Green School of Science,
Princeton College, Princeton, N.J.

ON SECONDARY BATTERIES.*

By GEORGE F. BARKER, Philadelphia, Pa.

A SECONDARY battery is one which produces a current in consequence of a previous electrolytic condensation or polarisation upon the surfaces of its plates. Electrolytic polarisation and the production of a secondary current by means of it are almost as old as the voltaic battery itself. In 1801, Gautherot, having used platinum or silver wires as electrodes in a solution of salt, noticed a momentary inverse current when the battery was replaced by a galvanometer. Ritter observed the same phenomenon in 1803 with gold wires. He constructed a secondary battery with pieces of gold separated by cloth disks moistened with salt water. After contact for some seconds with a Volta's pile of more pairs than itself, it produced a current to which Ritter gave the name of secondary current. Platinum, gold, and silver gave a more marked result than copper, brass, iron, or bismuth; and no effect at all was obtained from lead, tin, or zinc. Fifty disks of copper separated by disks of cloth moistened with salt or sal ammoniac solution, when charged with a Volta's pile of 100 pairs, gave a current which decomposed water and produced all the effects of the primary current. Volta himself, as well as Marianini, explained the results by supposing that the decomposition of the salt produced acidic and basic deposits upon the metal disks; a view which Becquerel apparently confirmed by immersing a platinum plate in an acid, and another in an alkali, and noting that the current was the same in direction as the secondary current. But in 1826 De la Rive obtained the secondary effect from platinum plates immersed in dilute sulphuric acid; and since no basic or acidic deposits were now possible, he regarded the phenomenon as a physical one due to a special or polarised condition of the plates themselves. The current he called a polarisation current. In 1833-4 Faraday's researches on electro-chemical decomposition definitely established the proportionality of the current to the amount of electrolyte decomposed. He observed the "peculiar state" of the plates in his voltameter; and even noticed that when lead acetate was electrolysed, metallic lead was deposited on the negative plate and lead peroxide on the positive; but he offered no explanation of these phenomena. In 1842, Grove, following out an observation of Matteucci, constructed a gas battery in which the current was produced from two plates of platinum immersed in oxygen and hydrogen gases respectively. In 1852, C. W. Siemens used two carbon plates in lead acetate solution as a secondary battery, obtaining, by the action of the current, lead on one of these plates and lead peroxide on the other. One cell of this battery decomposed water; so that the electromotive force of the current must have been nearly two volts.

In 1859 Planté began an elaborate research upon this secondary action, studying carefully the influence of the metal and of the solution employed. The maximum effect was given by lead plates immersed in dilute sulphuric acid; and in 1860 he produced secondary batteries of remarkable power by rolling two sheets of lead together, a strip of insulating material being between them, and placing them in a ten per cent sulphuric acid. When connected with a battery, the oxygen evolved upon the positive plate attacked it and converted its surface into

peroxide, the hydrogen for the most part escaping. When now the current was reversed the hydrogen reduced this peroxide to finely-divided metallic lead, and the oxygen attacked the other plate, producing peroxide. By such alternations the metal may finally be corroded to any depth, and the amount of finely-divided lead and peroxide indefinitely increased. In Planté's experiments this forming process required three months. In 1881 Faure brought out a secondary battery in which, as in Planté's, lead plates in sulphuric acid were employed. But in order to avoid the tedious process of "forming," in which the deposits upon the plates were produced by electric action, Faure covered the plates at the outset with a layer of minium or red lead. Upon passing the current this red lead was reduced to metallic lead on the one plate and oxidised to peroxide on the other; thus producing the battery charged and ready for use in a single operation requiring but a few hours.

The theory of the storage of energy by secondary batteries is not difficult. Energy is capacity of doing work, and work is force acting through distance. Whenever two attracting bodies are separated work is done upon the system and energy is absorbed by it; and this whether the attraction overcome is mechanical, molecular, or atomic. When an electrolyte is decomposed by an electric current, the current yields energy in proportion to the amount of the ions separated. The quantity of lead peroxide formed in a secondary battery represents the amount of energy stored from the current. So soon, however, as the separating force ceases to act the ions reunite and the stored energy becomes again free. Since the amount of energy thus set free, like that originally stored up, is proportional to the quantity of matter concerned, it is clear that the amount of electricity obtained from a given secondary battery is proportional to the amount of electrolytic products deposited upon its plates. In theory, the electrical energy set free should equal that originally stored up, but in practice this result is never attained.

In its primary expression the chemistry of the secondary battery is simple. In the form made by Grove two platinum plates are placed in acidulated water. Under the action of the current oxygen is set free on one of these and hydrogen on the other,* and the plates are said to be polarised. The electromotive force between these plates is the sum of the contact-potentials involved. Its value is 1.45 volts, and it measures the chemical attraction between oxygen and hydrogen. If now the two plates be connected by wire, the oxygen and the hydrogen recombine and the energy of combination appears in the form of a secondary current. In general, however, the electrolytic action is accompanied by secondary chemical changes which render the phenomenon much more complicated. In the lead battery, for example, secondary products appear at both electrodes. The oxygen set free at the anode combines with the lead, the final product there being peroxide. The hydrogen evolved at the cathode reduces the oxide which it finds there and produces metallic lead. As before, the electromotive force in the battery is the sum of the contact-potentials, and this, in the case of lead and lead peroxide, is a little above two volts.† When now the plates are connected by a conductor the entire process is reversed. Water is decomposed, and, since the immersed portion of the plates changes sign on discharge, the hydrogen now goes to the peroxide surface and oxygen to the finely-divided metallic lead. The former is deoxidised to monoxide, and the latter oxidised to the same condition. Simultaneously, a current flows through the conductor, the electromotive force of which is two volts, the strength of which is the ratio of this electromotive force to the resistances in circuit,

* Undoubtedly the oxygen is produced by a secondary reaction.

† Planté observes that, after complete charging, the electromotive force may rise above two volts at the instant of removing the battery. But as it falls to this value at once on closing the circuit and remains so, he attributes the first result to the temporary production of a peroxidised substance, as hydrogen peroxide or persulphuric acid, at the anode.

* From the *Proceedings of the American Association for the Advancement of Science*, Montreal Meeting, 1882.

and the duration of which depends upon the amount of secondary products deposited upon the plates during the charging. Beside this, however, another action takes place in the secondary battery which is of great importance. The sulphuric acid in which the plates are immersed attacks both the peroxide on the one plate and the metallic lead on the other, and converts both into lead sulphate. Moreover, as fast as the monoxide is produced by the discharge of the battery, it also is converted into sulphate; so that upon complete discharge the plates are precisely alike, both being covered with lead sulphate.

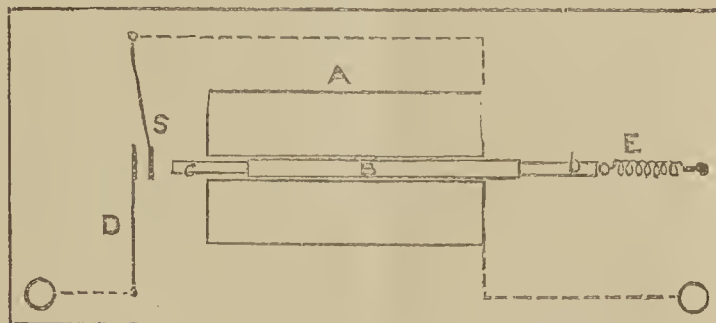
The secondary batteries employed for experiment were those of Planté and Faure. Of the former type, two cells of the larger size made by Breguet were used. Of the latter, one cell of medium size made by Reynier, and thirty-four cells of the size exhibited at the Electrical Exhibition at Paris, were experimented with. The battery of thirty-four cells was made in January under my direction.* Each cell consisted of six plates, each 20 by 60 centimetres, the lead being a millimetre thick. The exposed surface of each plate, therefore, was nearly 0.25 of a square metre, and of each cell about 1.50 square metres. For the whole battery the surface was about 50 square metres (exactly 48.96). Each plate was covered on both sides with a coating of red-lead about a millimetre thick made into a paste with water. Parchment-paper was then folded over the whole, and over this a covering of felt sewed together at the edges. The plates were then folded transversely and each pair intercalated. Heavy lead terminals were attached to each plate, and three pairs of plates were placed in each box, the terminals of one plate of each pair being united together and furnished with a connector. The boxes were lead-lined, and measured 31 c.m. in length, 25 in depth, and 11 in width. One of the two sets of plates was in contact with the lead lining, the other was insulated. The latter was always made the positive end. The total weight of a single cell was 17 kilograms.†

The charging current was generated by a Gramme machine whose field was maintained by an auxiliary dynamo. The maximum obtainable electromotive force of this current was 85 volts. In general, however, a much less electromotive force was used, sufficient only to give a current of from 10 to 20 amperes through the thirty-four cells arranged in series. Currents as high as 45 amperes, however, were occasionally employed. At the outset considerable difficulty was experienced from the discharge of the battery when from any accidental cause the current fell below the potential of the thirty-four cells. The wear of the brushes of the auxiliary dynamo sometimes opened its circuit and thus destroyed the magnetic field of the Gramme. There being now no counter electromotive force to oppose it, the secondary battery flowed back

through the machine, discharging the battery completely. A simple device was arranged to prevent loss of the charge in this way should the charging current become weakened. This device is represented in Fig. 1, where A is a coil of No. 10 copper wire. Within its core is a rod of iron, B, prolonged at both ends by brass rods of smaller diameter, b and c, these being supported upon rollers. Opposite the end of one of these rods is a flat spring, s, faced with platinum and making contact when depressed with a similar brass strip D, also faced with platinum. The course of the current is shown by the dotted lines. When the circuit is closed between s and D, the current traversing the coil draws the iron bar strongly into its axis, and the end of the brass rod pressing against s holds the circuit closed. Should the current weaken, the spring s reacts against the rod, pushing it back and opening the circuit. By means of an auxiliary spiral spring, E, the instrument may be adjusted to any required current-strength. It would seem that by no possibility can the accumulated charge in the battery be lost when this automatic cut-out is in circuit. As now described, the coil is of large wire, and the entire current passes through it; but a second form of it has been used in which the coil is made of finer wire, and is placed in a shunt circuit, as shown in Fig. 3. In both cases, of course, the entire current passes through the contact springs.*

After charging, the current from the secondary battery was used to maintain seventeen Edison incandescent lamps of the B pattern. More frequently, however, the

FIG. 1.



battery was used in connection with the Gramme machine. The source of power being an Otto gas-engine which, at best, has an explosion only every fourth stroke, the motion appears very irregular when tested by so delicate a method. As every explosion increases the speed, the higher electromotive force developed increases for an instant the brightness of the carbon filament, producing a marked pulsation in the light. If now a secondary battery of nearly the same electromotive force be placed in multiple circuit with the machine and lamps it acts as an equaliser, and destroys entirely the pulsations. Figs. 2 and 3 show the arrangement actually employed, in which B is the secondary battery and L the lamps, the automatic cut-out being at c. When the circuit is opened at a, b and c being closed, the lamps are fed by the machine alone; when opened at b, a and c being closed, by the battery alone: when at c, a and b being closed, the machine charges the battery. When all three are closed, the lamps are fed by the machine and battery together, the latter acting as an equaliser. A galvanometer inserted at a, c being opened and b closed, indicates the charging current: when c is closed and b open, the discharge current; and when b and c are both closed, the equalising current. If the electromotive force of the machine current be but slightly in excess of the battery current, the deflection to the right in the first case will about equal that to the left in the second; so that in the third case the deflection is practically zero, not the least spark appearing on opening at a; and this,

* This battery, as well as the cut-out, Fig. 1, was made by Jas. W. Queen and Co., of Philadelphia.

† Mr. W. Lachlan, the electrical engineer of the Light and Force Co., New York, has kindly furnished me the following figures concerning the Faure batteries of improved construction recently imported in the steamer *Labrador*. Four types of Faure batteries are made in Paris, called A, B, C, and D. Type A consists of seven positive plates, each 37×23.5 c.m., and 3 m.m. thick, perforated with holes 6 m.m. in diameter 10 m.m. apart, alternated with seven negative plates of the same size, but only 0.5 m.m. thick, and similarly perforated. The seven positive plates weigh 16.66 kilograms.; the seven negative ones 2.77 kilograms. The red-lead spread on their surfaces weighs 22.13 kilograms., the two exterior plates being covered only on their interior surfaces, so that there are twenty-six active surfaces in all. Each plate has an electrode 7 c.m. wide. The box is 45×20×40 c.m. in size, is pitched throughout, and weighs with its cover 10 kilograms. The battery complete, ready for charging, weighs 63 kilograms. In type C there are five positive plates each 24×19 c.m., 3 m.m. thick, and four negative plates 0.5 m.m. thick, both perforated with holes 5 m.m. in diameter, and a centimetre apart. The positive plates weigh 7.14 kilos., the negative 0.888 kilo. Sixteen surfaces are covered with red-lead, weighing 8.28 kilos. The electrodes are 3.5 c.m. wide. The box weighs 3 kilos., and the battery complete 20.37 kilos. Each cell of type A contains, it is claimed, when fully charged, 375 ampere-hours of current delivered at an electromotive force of 2 volts. Hence it will furnish, for example, a current of 25 amperes for fifteen hours. Type C contains 153 ampere hours. Types B and D are round cells in jars of earthenware. The former weighs 35 kilos., and contains 225 ampere-hours: the latter 8 kilos., and contains 75.

* Sir W. Thomson has devised a polarised cut-out for this same purpose. He exhibited it at the York meeting of the British Association in September last.

though the pulsations are completely destroyed, the light being perfectly steady. The advantage of a much more agreeable light is thus secured; but, in addition, the life of the lamps must be increased by the use of this steadier current, as it has been shown to be by using the secondary battery alone.

On the 27th of February the battery was charged continuously for fourteen hours, or until hydrogen was freely evolved from each of the 32 cells employed. It then gave an electromotive force of 59.3 Daniell cells; or calling the Daniell 1.08 volts, of 64.04 volts. On the 10th of June, the same 32 cells gave an electromotive force of 56.7 Daniell's, or 61.2 volts. On the 24th of June, their electromotive force was 54.3 Daniels, or 58.6 volts. It may be assumed then that the average electromotive force of a single cell was not far from 2 volts. This value has never been exceeded in any of the measurements made, either on single cells or on groups of cells. When first made the resistance of the single cells was low, about 0.02 ohm; but subsequently the internal resistance increased considerably, rising even to twice this value.

The chief defect of the secondary lead battery is the local action which takes place in it. By local action is meant any deterioration in the efficiency of a battery which occurs when it is left on open circuit. This defect was noticed by Planté, who says: "If the lead peroxide deposited on the positive plate had no tendency to spontaneous reduction in the acidulated water, by forming a local circuit with the metal that it covers, the preservation of the charge taken by the secondary couple should be indefinite. But this peroxide is reduced, and with the more facility, as the layer of it is thinner. In a new secondary couple the charge cannot be preserved." In a well-formed battery he attributes the preservation of the charge to a reduction of the superficial layer to monoxide, which acts as a protecting coating. Another local action, however, takes place in this battery which appears to be of more importance. This is the action of the sulphuric acid upon the products of electrolysis. The finely-divided lead on the negative plate, as well as the peroxide upon the positive, is alike converted into sulphate by this action. When the circuit is closed this action is normal; but it takes place equally well when the circuit is open. It is then abnormal and of course injurious. The formation of lead sulphate in the secondary battery has been studied by Gladstone and Tribe.* They found that with a Planté cell the whole of the peroxide formed on charging was converted into white sulphate within seventeen hours. The same fact was observed with the Faure battery. So far, however, from regarding this formation of sulphate as wholly injurious, they regard it as "absolutely requisite in order that the charge should be retained for a sufficient time to be practically available." They believe that the insoluble lead sulphate clogs up the interstices of the peroxide and after a while forms an almost impermeable (*sic*) coating between it and the lead plate; so that the mass of peroxide which is in contact with the lead plate expends its energy slowly, while the same mass of peroxide, brought into connection through its own lead plate with another lead plate at a distance, expends its energy even through the sulphuric acid, in a tenth or a hundredth part of the time.

My experiments with the Faure battery above described confirm entirely those of Gladstone and Tribe as to the formation of lead sulphate. In several cases, the acid in charged cells disappeared entirely on standing, so that the water was tasteless; and in some instances this was repeated three times with the same set of plates. This action increased very greatly the internal resistance, first by replacing the acid by water, and second by forming the higher resistant sulphate. On examining the plates, lead sulphate formed the entire coating upon both of them. On attempting now to re-charge such a cell, this notable increase in the resistance showed itself in the reduced

current transmitted by the same electromotive force. Gradually, however, the resistance fell, and the current finally regained its normal strength. In one instance, the charging current rose from 2 amperes to 12 in four hours, 28 cells being in circuit, arranged in series. It was observed, however, that when the current was first applied, torrents of gas were evolved from both plates; and that as the charging process went on the oxygen was first completely absorbed, and then the hydrogen. When the charge was nearly complete the evolution of hydrogen reappeared. There would seem, therefore, to be a very considerable loss of energy, due to the resistance consequent upon the formation of sulphate. In the first place the current energy is wasted as heat in the cells; and in the second, a large portion of it is dissipated in the evolved gases.

Another defect of considerable magnitude is developed when a number of secondary cells is placed in series, and is due to a want of uniformity in their capacity for storage. This arises, probably, first, from the difficulty of constructing them exactly alike originally, and second, from the impossibility of uniform action among them on charge and discharge. The difference in the cells of the same

FIG. 2.

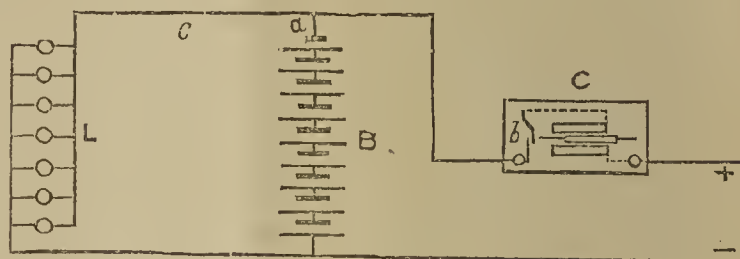
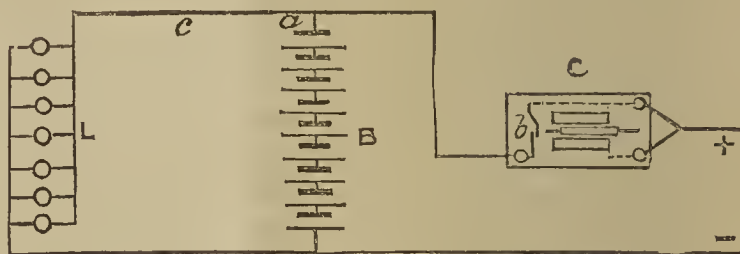


FIG. 3.



battery even, when they all have been treated precisely alike, is surprising. On the 14th of June, 32 cells were freshly charged, and the current strength from each cell measured on a tangent galvanometer. Eleven cells gave 80° deflection each, seventeen gave 79° each, one gave 78°, one 77°, one 75°, and one 20°. When seventeen Edison B lamps were placed in circuit, the discharge deflection of the thirty-two cells in series was 67°. On the following day the battery was charged again, and, after an hour's use on the lamp circuit, was again tested. Those giving a deflection of 87° were two; of 86°, two; of 84°, two; of 83°, one; of 81°, one; of 78°, five; of 77°, two; of 76° one; of 13°, three; of 11°, one; of 10°, three; of 8°, one; of 6°, one; of 5°, three; of 4°, one; of 2°, one; of 1°, one; and of 0°, one. Obviously, so long as any peroxide is present, the electromotive force is constant; hence this wide variation of current strength must be attributed apparently to the variation of the resistance in the different cells. But this is not the worst aspect of the matter. If the discharge be continued for a longer time, some of the cells become exhausted sooner than others, and are then charged in the inverse direction by the current from the rest. On the 12th of June, the thirty-two cells, after pretty complete discharge, were measured as above. Nineteen cells gave positive deflections ranging from 87° to 5°; thirteen gave negative deflections varying from 13° to 1°. Faraday said of primary batteries in 1834, that "weak and exhausted charges should never be used

* *Nature*, xxv., 221, 461; xxvi., 251, 1882.

at the same time with strong and fresh ones in the different cells; and this remark is even more applicable to secondary batteries, where this condition is more liable to occur. Not only does a dead cell introduce resistance into the circuit, but what is of more importance, its reverse polarisation introduces a counter-electromotive force, so that every such cell neutralises another cell, the dead resistance of which is also added to the circuit. In consequence, it is not safe in practice to draw from a secondary battery all the energy it should be capable of yielding, and in most cases not more than half can be safely taken out of it. In place of continuing uniform as in a single cell, the electromotive force of a series of cells begins to fall when about half the charge which it ought to be capable of yielding has been drawn from it. The practical result is that to supply for lighting a definite number of coulombs of electricity, a secondary battery of twice the size is necessary under these circumstances.

With reference to the two forms of lead secondary battery devised by Planté and by Faure respectively, my experiments show that while the electromotive force is the same in both, and while the internal resistance and storage capacity may readily be made the same, yet that the local action is far less when the peroxide is formed by the action of the current upon the lead plate itself than when it is produced from minium spread upon it. The rapidity of the formation of the peroxide is proportional to the density of the current; but when rapidly formed it is fine and spongy. In one of my Planté cells, the peroxide is beautifully crystalline and very hard. Not a trace of sulphate has been formed in it apparently, though it has been in use for six months, and has been frequently charged and discharged during that time. The necessarily finer condition of the peroxide in the Faure battery would seem to predispose it to a more considerable local action. True, the Faure battery requires very much less time than the Planté to form it. But this is more than compensated by the increased permanence of the latter. With an equal storage capacity, as in M. de Kabath's form of Planté cell, it would appear that in efficiency it will surpass the form devised by Faure.

The commercial aspect of the question of the storage of electrical energy has recently assumed a very considerable importance. But it is evident at the outset, that an agent, which has been produced and then stored, must cost more when re-delivered than when first produced, by exactly the cost of the storage; that is, supposing there is no loss in storing. But there is a loss, and this is almost if not quite one-half of the energy involved; as it would seem from the Conservatoire experiments in Paris, among others. The first cost of the accumulators, the expense of charging them, their low efficiency, and especially their bulk and weight, must ever prevent, it would seem, their competing successfully with the direct use of the dynamo-electric machine, at least with any form of secondary battery yet devised. For special uses, however, the storage battery has a high value. Even if the cost of an ampere of current produced by it is twice as great as if produced directly by the dynamo-machine, this cost is only one-half of that required to give the same current by any available form of primary battery. Where a strong current of low electromotive force is needed, under conditions where a dynamo cannot be employed, there the secondary battery has its most important field. Its value rapidly decreases as the number of cells is multiplied, as when a high electromotive force is needed for the production of light. Its chief advantage is its transportability; since by placing it near the work to be done, the loss of energy on long conductors is obviated.

Weathering of Marley Detritus and the Changes produced by Cultivation.—Prof. A. Orth.—The upper stratum of soil in comparison with the sub-soil becomes richer in lime, carbon dioxide, and phosphoric acid, but poorer in potassa.—*Biedermann's Central-Blatt.*

ON THE
PREPARATION OF CERIUM OXIDE.

By M. H. DEBRAY.

FIVE hundred grammes of cerite, finely powdered, are stirred up in, at most, an equal weight of water, and 375 grammes of concentrated sulphuric acid are added whilst the mixture is being rapidly stirred. This operation is performed in a large platinum capsule with a flat bottom. The mixture becomes hot, swells up, and is rapidly converted into sulphates of the earths of cerite, and into gelatinous silica. The whole is evaporated until dense fumes of sulphuric acid begin to appear, stirring all the time to prevent the mass from adhering to the bottom of the capsule. The matter is then pulverulent, and the silica has become insoluble. When it is quite cold, it is thrown, little by little, into water kept at 0° by means of ice (5 or 6 litres at least); the sulphates, which are slightly acid, dissolve readily in the water if we prevent the rise of temperature which accompanies hydration. The liquid is filtered off and treated with a current of hydrogen sulphide; when saturated with this gas it is let digest for twenty-four hours. A complex mixture of copper, bismuth, molybdenum, &c. sulphides, is deposited. The mixture is heated to cause these sulphides to be perfectly precipitated, and filtered. The rose-coloured filtrate is precipitated with concentrated oxalic acid. There is formed an abundant curdy deposit, which collects at first in a soft state at the bottom of the vessel, and is rapidly converted into a crystalline powder of the acids of the cerite earths. The acid liquid contains lime and iron. The oxalates are washed by decantation and converted into nitrates by attacking them with hot concentrated nitric acid.

So far the treatment indicated does not essentially differ from that commonly adopted for extracting from cerite the mixture of earths discovered by Mosander. It is chiefly in the treatment of the nitrates for obtaining cerium oxide that the process is distinguished from those hitherto adopted for separating ceroso-ceric oxide from the didymium and lanthanum oxides.

The mixture of nitrates is melted with 8 or 10 parts potassium nitrate in a porcelain capsule, and the fused mass is kept between 300° and 350° by means of a gas furnace. Cerium nitrate is decomposed, forming a yellowish powder of cerium oxide, which retains a little nitric acid, but didymium and lanthanum nitrates, when melted with nitre, are not appreciably decomposed, even at 350°. A thermometer, plunged into the bath of nitrate, indicates its temperature. When the escape of nitrous fumes ceases, which requires several hours, the operation is stopped. When cold the melted mass is easily detached from the capsule, and the cerium oxide is found collected at the lower part. It is dissolved in water, and there remains a powder, yellowish if it contains mere traces of didymium, but reddish if it contains more. It is well to wash with a little weak nitric acid, which dissolves a little didymium sub-nitrate produced at the same time as the cerium oxide if the capsule is too strongly heated at certain points. This is of little consequence as the cerium oxide obtained in the first operation always requires to be purified.

It may be entirely freed from didymium by transforming it into nitrate, which is melted a second time with 8 or 10 parts potassium nitrate. For this purpose the oxide is attacked with sulphuric acid diluted with an equal volume of water, taken up with water when everything dissolves if the liquid is sufficiently acid. The yellow ceroso-ceric sulphate thus obtained is reduced with sulphurous acid, and the cerous sulphate is precipitated with oxalic acid. The cerous oxalate is then readily converted into nitrate by boiling with nitric acid. This second treatment gives a yellow powder, which contains neither didymium nor lanthanum, as the nitrate of the latter earth is still more stable than that of didymium. If it is

transformed into colourless cerous sulphate the spectro-scope does not detect the least trace of this body, which is always easy to recognise by its absorption-spectrum. The didymium and lanthanum nitrates which remain mixed with a large excess of potassium nitrate are evaporated and re-melted, the temperature exceeding 350° . The remaining trace of cerium nitrate which has escaped decomposition in the former operation is completely destroyed, and there is even formed a small quantity of didymium sub-nitrate. But the bulk of the didymium remains with the lanthanum in the state of a soluble nitrate.

We have thus a certain and rapid method of obtaining the oxide or the salts of cerium free from didymium and lanthanum, or, on the other hand, a mixture of these two oxides absolutely free from cerium.—*Comptes Rendus*.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 19, 1883.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

THE following certificates were read for the first time:—C. Beringer, H. E. Harrison, C. Hulke, E. H. B. Stephenson, A. Smith. During the evening a ballot was held, and the following gentlemen were declared by the Scrutators, Messrs. Spiller and Groves, to be duly elected Fellows:—T. L. Briggs, J. A. Basker, J. B. Coleman, W. H. Cannon, E. C. Conrad, C. Gillett, E. C. Hemming, N. K. Humphreys, L. Levy, A. Ness, V. T. Schopoff, A. E. Wilson.

The PRESIDENT called on Dr. PERCY FRANKLAND to read a paper "*On the Gases evolved during the Conversion of Grass into Hay*," by P. F. FRANKLAND and F. JORDAN. About 5 grammes of finely-cut grass were imprisoned in a small retort adapter, which was then filled with mercury, the small end of the adapter corked up, the cork protected by a mercury cup, and the whole allowed to remain over mercury during the observation. In atmospheric air at 15° C., 3 c.c. of gas were evolved in three days, and 4 c.c. more in thirty days. The gas in the first case was composed of— CO_2 , 46.35 per cent; O, 0.07 per cent; N, 53.58 per cent. In the second case— CO_2 , 85.33 per cent; O, 0.00 per cent; N, 14.67 per cent. Other experiments were made in which the grass was surrounded by atmospheres of carbonic anhydride, of hydrogen, and of oxygen, with almost similar results. The authors conclude that the atmosphere with which the grass is surrounded has but little influence either upon the volume or the composition of the gas evolved. The grass in every case undergoes a rapid process of oxidation, in which it speedily removes all the oxygen from the atmosphere, with which it is surrounded, and in the absence of any oxygen in the free state, with which to combine, much carbonic acid is produced at the expense of the combined oxygen present in the grass. When, however, free oxygen is present in the atmosphere surrounding the grass, the gas evolved contains a considerable proportion of nitrogen. At a temperature of 36° C. more gas is evolved than at 15° . In all cases carbonic anhydride is the chief product of decomposition, whilst hydrogen and hydrocarbons appear in only very small quantities. The authors have made similar experiments as to the gases evolved by grass when kept under water. Large volumes of gas are evolved (about five times as much as in the previous experiments), which are characterised by the presence of a notable proportion of hydrogen, which is doubtless due to the lactic fermentation induced by bacteria: acetic, lactic, and probably propionic acids with bacteria being found in the water. If the water

contain phenol or mercuric chloride, or if the grass be steamed, no gas is evolved.

Dr. VOELCKER said the paper was peculiarly interesting, not only from a scientific point of view, but from its direct bearing on the making of hay in wet weather, and on the preservation of grass as "ensilage." The changes observed when the grass was immersed in water were those which take place in the "silo." He had examined some "ensilage" from Boston, and had found considerable quantities of propionic and acetic acids. These acids are the best preservers of green food; the grass is, in fact, pickled. Well-made ensilage can be exposed without becoming mouldy; it contains no sugar. It would be interesting to know to what extent, as indicated by loss of weight, the changes observed by the authors had taken place. He had made some observations at Rothamsted on a stack of hay, made in dry weather under the most favourable conditions, and the loss was only 5 per cent. On the other hand, a stack made in wet weather at Cirencester, had become so hot that it had to be taken down, and the quantities of carbonic anhydride, aldehyd, and acetic acid completely overpowered the men employed. In the lower part of this stack the grass was completely calcined, and 5 or 6 lbs. of ash were collected. Now it would be extremely interesting to determine quantitatively the loss which grass undergoes when improperly stacked, and to study the effect of temperature on these changes.

The PRESIDENT asked if any experiments had been made as to the composition of the combustible gases evolved; whether any marsh-gas was present?

Dr. PERCY FRANKLAND said he had not been able to weigh the grass after the experiments, and that most of the combustible gas was absorbed by strong sulphuric acid.

Dr. L. T. THORNE then read a "*Note on an Apparatus for Fractional Distillation under reduced Pressure*." By means of this apparatus, which was exhibited by the author, the various fractions can be removed from time to time without impairing the vacuum, and the distillation can therefore be continued from beginning to end without interruption. If the substance under distillation is affected by exposure to the air, any inert gas can be introduced instead of air without disturbing the apparatus.

The PRESIDENT said that the apparatus had been in use in his laboratory for some time; it seemed to be very convenient, and answered extremely well.

Mr. W. H. DEERING then read a paper entitled "*Notes on the Condition in which Carbon exists in Steel*," by Sir F. A. ABEL, C.B., and W. H. DEERING. Two series of experiments were made. In the first series discs of steel 2.5 inches in diameter and 0.01 inch thick were employed. They were all cut from the same strip of metal, but some were "cold-rolled," some "annealed," and some "hardened." The total carbon was found to be "cold-rolled," 1.108 per cent; hardened, 1.128 per cent; and annealed, 0.924 and 0.860 per cent. Some of the discs were submitted to the action of an oxidising solution consisting of a cold saturated solution of potassium bichromate with 5 per cent by volume of pure concentrated sulphuric acid. In all cases a blackish magnetic residue was left undissolved. These residues, calculated upon 100 parts of the discs employed, had the following compositions:—"Cold-rolled" carbon, 1.039 per cent; iron, 5.871. Annealed, C, 0.83 per cent; Fe, 4.74 per cent. Hardened, C, 0.178 per cent; Fe, 0.70 per cent. So that by treatment with chromic acid in the cold nearly the whole of the carbon remains undissolved with the cold-rolled and annealed discs, but only about one-sixth of the total carbon is left undissolved in the case of the hardened disc. The authors then give a *resumé* of previous work on the subject. In the second part they have investigated the action of bichromate solutions of various strengths on thin sheet-steel, about 0.008 inch thick, which was cold-rolled, and contained—Carbon, 1.144 per cent; silica, 0.166 per cent; manganese, 0.104 per cent. Four solutions were used. The first contained about 10 per cent of bichromate, and 9 per cent of H_2SO_4 by weight;

the second was eight-tenths as strong, the third about half as strong, the fourth about one and a half times as strong. In all cases the amount of solution employed was considerably in excess of the amount required to dissolve the steel used. A residue was obtained as before. With solution 1, the residue contained, C, 1.021; sol. 2, C, 0.969; sol. 3, C, 1.049 (the atomic ratio of iron to carbon was Fe, 2.694 : C, 1; Fe, 2.65 : C, 1; Fe, 2.867 : C, 1); sol. 4, C 0.266, per 100 of steel. The authors conclude that the carbon in cold-rolled steel exists not simply diffused mechanically through the mass of steel, but in the form of an iron carbide, Fe_3C , a definite product, capable of resisting the action of an oxidising solution (if the latter is not too strong), which exerts a rapid solvent action upon the iron through which the carbide is distributed.

Mr. SPILLER said that there was perhaps a possibility of decomposing the carbide of iron if all the iron present was dissolved, and suggested that it would be preferable to leave a little iron undissolved to prevent this risk.

Mr. DEERING said that it seemed to him the only natural stopping-point was to dissolve as much as possible with a given solution, and examine the residue.

"On the Spectrum of Beryllium, with Observations Relative to the Position of that Metal among the Elements," by W. N. HARTLEY. Owing principally to the difficulty of obtaining beryllium pure it is still questionable whether beryllium is a triad with atomic weight 13.8 and oxide Be_2O_3 , or a dyad with atomic weight 9.2 and oxide BeO . The author has photographed the spark spectrum from a saturated solution of the chloride, prepared from pure oxide, presented to him by Dr. Emerson Reynolds, and concludes that beryllium is the first member of a dyad series of elements, of which in all probability calcium, strontium, and barium are homologues.

The Society then adjourned to May 3.

PHYSICAL SOCIETY.

Saturday, April 14th, 1883.

Professor G. C. FOSTER in the Chair.

NEW members—Mr. W. F. Smith, Mr. George Forbes, M.A.

Mr. W. LANT CARPENTER read a paper on "Science Demonstration in Board Schools," in which he showed the drawbacks of the present system of leaving science to be taught by the other masters, and pointed out the marked advantages of the system followed in Birmingham and Liverpool, where skilled lecturers are appointed to go from school to school, and provided with an assistant demonstrator and proper apparatus. Mr. Carpenter advocated the extension of this system to London and the country in general. He also showed the evil of the present system of cramming for examinations.

Dr. W. CARPENTER pointed out the advantages of object lessons in training the minds of children.

Dr. J. H. GLADSTONE stated that much had been done in London to introduce object lessons, and that under the Mundella code science would be taught in all Board Schools to all the children, who, however, might have the opportunity of choosing between science and literature.

Mr. W. BAILY, Prof. FOSTER, and Prof. W. CHANDLER ROBERTS also advocated the system of special science teachers.

Prof. ROBERTS then took the Chair, and

Mr. GLAZEBROOK explained a New Polarising Prism, which he had devised to prevent displacement of the pencil of rays. He also showed how the curved diffraction gratings of Prof. Rowland do not always give perfect definition, and calculated the aberration of the rays.

The SECRETARY then read a paper by Mr. W. H. STOKES and Mr. A. E. WILSON on "Experiments on the Viscosity of Saponine." When a disc is rotated in water

the resistance to its motion is greatest when the plate is immersed a little below the surface; but with saponine the viscosity is greatest when the disc is not wholly but only partially immersed below the surface.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 14, April 2, 1883.

This number is taken up with the awards of the prizes which are yearly given by the Academy.

Biedermann's Central-Blatt für Agrikultur-Chemie, Vol. xii., Part 2.

Distribution of Ammonia in the Air and in Atmospheric Waters at Great Elevations.—A. Müntz and E. Aubin.—Already noticed under *Comptes Rendus*, xcv., p. 788.

Temperature at the Surface of the Soil and in the Earth down to a Depth of 36 metres, also on the Comparative Temperature of Bare and of Grass-grown Soils.—E. and H. Becquerel.—Noticed under *Comptes Rendus*, xciv., p. 1147.

Purification of Polluted Waters.—Prof. J. König.—The author proposes to purify town sewage and the waste-waters of slaughter houses, dye works, breweries, &c., by allowing them to trickle over a net-work of wire, thus exposing a large surface to the oxidising action of the atmosphere. He recommends that the coarser impurities should first be got rid of by means of settling tanks, and he mentions that the same result has been aimed at by allowing the water to flow over "graduation works," i.e., thorns or bushes piled up in the shape of a high thin wall.

Denitrifying Ferment of Arable Soil.—MM. Gayon, Dupetit, Dehérian, and Maquenne.—Noticed under *Comptes Rendus*, xcv., 644.

Reduction of Sulphates by Algæ.—A. Etard and L. Olivier.—Noticed under *Comptes Rendus*, xcv., 846.

Behaviour of Difficultly Soluble Phosphates in Moorland Soils and with certain Feeble Solvents.—Dr. M. Fleischer.—The soil of the high moorlands appears to have a decided solvent power upon so-called insoluble phosphates. 100 parts of air-dried moor soil brought into solution 0.4317 phosphoric acid.

Experiments on the Action of Different Manures upon the Quantity and Quality of the Wheat Crop.—Prof. W. H. Jordan.—Phosphoric acid from bone-black superphosphate was found to increase the yield more than any other plant food. The addition of potassa, and especially of potassa and nitrogen, to the phosphoric acid gave an increased return of grain, and still more of straw. An increase of the nitrogen did not effect any proportionate increase of the harvest. The increase of the crop by the application of farm-yard manure was less decided than a complete dressing with artificial manures. Lime, ground limestone, and gypsum produced no effect worth mention.

Influence of the Moisture in Moor Soils upon Vegetation.—Prof. R. Heinrich.—Moor earth seems able to retain about 10 per cent of moisture so energetically that it cannot be appropriated by vegetation.

Sewage Irrigation at Osdorf near Berlin.—The result, according to the *Allgem. Zeit. für Deutsche Land-*

wirthe, is a failure. The water supersaturates the soil. Italian rye-grass is the best crop, but it must be consumed or sold green as drying is out of the question. Strawberries, raspberries, and gooseberries bear very large fruits, but they have neither sweetness nor flavour.

Moniteur Scientifique, Quesneville.
March, 1883.

Caoutchouc.—A. Lévy.—A lengthy memoir, in which the author considers the history of caoutchouc, the plants from which it is obtained, its extraction, the manufacturing processes to which it is submitted, and its commerce.

Review of Recent Researches concerning Mineral Chemistry.—These consist of papers on thorite and on the atomic weight of thorium, by M. L. V. Nilson, already noticed; on the atomic weight and the properties of uranium, by M. C. Zimmermann; and on the earths of Samarskite, by Professor Roscoe, disproving the alleged existence of philippium.

The Metallurgy of Copper.—Prof. Sterry Hunt.—From the *Journal of the American Institute of Mining Engineers*.

Steel of Dies for Coining.—C. von Ernst.—An account of certain analyses of steels used for this purpose by Prof. W. Chandler Roberts.

The Presence of Vanadium in an Ore from Leadville.—Dr. Malvern W. Iles.—The ore contains 9 per cent of vanadic oxide combined with lead.

Preparation of Carbonated Sodium and Potassium Aluminates.—These compounds are obtained by pouring slowly a solution of sodium or potassium aluminate into the solution of an alkaline bicarbonate traversed by a current of carbonic acid gas. The carbonated aluminates are insoluble in water, and are proposed to be used for obtaining salts of aluminium free from iron.

Oxygenated Water: its Industrial Uses, and its Employ in Surgery and Medicine.—Dr. P. Ebell.—The author's method of preparing oxygenated water, said to be more economical than that of Thenard, is not described. The product is recommended for bleaching hairs, feathers, silk, ivory, &c., after fatty matter has been previously removed by treatment with ammonium carbonate or benzol.

The Manufacture of the Sulphocyanides.—An account of the principal applications of the sulphocyanides. For the volumetric analysis of these salts an average sample of 3 to 5 grammes is dissolved in water, diluted to 500 c.c., and filtered, if needful. The solution is poured into a burette with a ground-glass tap. 10 c.c. of a decinormal solution of silver nitrate are measured off into a porcelain capsule, along with 1 to 2 c.c. of a solution of iron nitrate, and the sulphocyanide is allowed to flow into this mixture until a permanent red colour is obtained. This colour does not obtain as long as any silver remains in solution. Each c.c. of the silver solution represents 0.00580 gramme sulphocyanogen, or 0.00590 hydro-sulphocyanic acid. To prepare the ferric nitrate above mentioned 2 to 5 grammes of pianoforte wire are dissolved in nitric acid, evaporated in the water-bath to expel excess of acid, and made up to 100 c.c. with distilled water.

Accessory Products of the Gas Manufacture.—W. Siemens.—From Dr. Siemens's address before the British Association.

Recovery of Sulphur from Alkali Waste.—Carl Opl.—A portion of the lixivium is treated with hydrochloric acid and the hydrogen sulphide evolved serves to render fresh quantities of the calcium sulphide soluble. Another portion is left in contact with the air, and when it has absorbed a sufficient quantity of oxygen so that the sul-

phur acids may decompose each other, as in the processes of Mond and Schaffner, it is acidulated with hydrochloric acid, and the precipitate of sulphur is collected.

Assay of Linseed Oil.—In a small flask there are mixed equal measures of the oil, boiled or raw, and of nitric acid of sp. gr. 1.40. The mixture is shaken briskly for half a minute, and let stand for some time. When the separation of the oil and the acid is complete, the colour of the two strata is examined. If the upper layer is of a light cinnamon and the lower colourless, the sample is pure. If the upper stratum is either as above, of a deep olive, or a black, whilst the lower is straw-colour or orange, resin is present in quantities from 5 to 50 per cent, according to the intensity of the colour. If the upper layer is cinnamon-brown whilst the lower is colourless, the sample is genuine boiled oil. If the upper stratum is olive or black, and the lower of a paler or darker straw up to an orange, resin oil is present from 5 to 50 per cent.

Antiseptic Properties of Carbonic Acid.—Prof. H. Kolbe.—The author finds that beef in an atmosphere of carbonic acid may be kept for weeks without putrefaction, retaining its original flavour. Mutton behaves differently, and becomes offensive after a week. Fish, lobsters, oysters, and fruit remain fresh only a very short time. The author does not consider that the process is practically available.

Trans-caucasian Petroleum.—From the *Journal of the Society of Arts*.

Opium of Bulgaria.—A. Teegarten.—One of the samples examined contained as much as 20.73 per cent of morphine.

Composition of the Cylinders employed in Calico-Printing.—J. Depierre and Paul Spinal.—The metals best suited for printing are pure copper and alloys containing from 25 to 30 of zinc to from 75 to 70 of copper. Lead, even if present to the extent of $\frac{1}{2}$ per cent, is injurious. The introduction of 1 per cent of phosphorus in brass renders the grain more homogeneous.

New Process of Manufacturing Aluminium.—An account of the Webster process, taken from the *Pall Mall Gazette*.

The Medicinal Oleates.—Dr. Squibb.—This paper is rather medical than chemical in its character.

An Investigation on the Sophistication of Quinine Sulphate supplied to the Hospitals.—Cinchonine appears to have been extensively substituted for quinine in a large quantity of the drug supplied to the Paris hospitals.

Gallocyanines.—Horace Kœchlin.—Inserted in full.

The Industrial Society of Mulhouse.—Session of the Chemical Committee, January 10, 1883.—M. Albert Scheurer demonstrated that zinc and magnesium chlorides in sizing attack cotton very strongly. He recommends the use of calcium chloride in their stead.

M. H. Kœchlin read a note from M. Lussy on the direct fixation of antimony sulphide upon tissues by means of sodium sulphantimoniate. The sulphide thus fixed may serve either as a brown mineral colour or as a mordant for methylene blue, malachite green, magenta, &c., which may thus be fixed as firmly as by means of tannin followed by a passage through tartar emetic.

M. Camille Kœchlin exhibited alumina as transparent as glass derived from the decomposition of the tribasic acetate by spontaneous change from the liquid to the solid state. This acetate remains liquid below 10°, but above this temperature it solidifies. The salt has then lost its solubility, and is not affected by alkalis.

MM. Noelting and Collin have prepared, by the action of nitric acid upon ethyl-acetanilide in sulphuric solution, para-nitro-ethyl-acetanilide fusible at 118°.

MM. Noelting and Cohn have prepared oxyazoic compounds of the mesitylene series by causing diazoic derivatives to react upon mesitol in an alkaline solution.

Medicinal Resorcin and Pheno-resorcin.—F. Re-
verdin.—The physiological action of resorcin is very
similar to that of phenol. It is poisonous, but on account
of its great solubility and rapid elimination it is less apt
to accumulate in the system. Pheno-resorcin is not a
new compound, but a mere mixture of phenol and resorcin,
and is used as an antiseptic.

**Use of Finely-divided Lead for the Examination of
Drying Oils.**—A. Livache.—The lead is obtained by
precipitating with slips of zinc a 10 per cent solution of
lead nitrate acidulated with a few drops of nitric acid.
The precipitate obtained is agitated for a few moments
with distilled water, washed by decantation two or three
times; thrown into a funnel plugged with glass wool,
washed quickly, first with alcohol and then with ether,
and dried in a vacuum over sulphuric acid. To expel traces
of ether it is lastly exposed to the air in thin layers for
about two hours. For the examination of an oil, 1 gramme
of the lead is spread out in a rather large watch-glass,
and the oil in question is allowed to fall drop by drop
from a pipette drawn out to a point, placing the drops in
such a manner that a space may remain between them.
The lead gradually sucks up the oil, so that every frag-
ment is coated with an excessively thin film of oil. If the
oil has been added in to great quantity it forms a thick
coating, which dries at the surface, and forms a solid
pellicle, which protects the lower part. About 2 parts of
oil at most should be used for 3 parts of lead. The watch-
glass should have been first tared; the lead is then
weighed, and afterwards the oil added. The watch-glass
is then exposed to a mean temperature and to full light,
which materially aids oxidation. With drying oils the
increase of weight sets in after about eighteen hours, and
is generally at an end after three days, when it remains
constant. With non-drying oils the weight generally
does not begin to vary until after four or five days.
Numerous series of experiments have shown the following
numbers as the limits of the increase of weight of oils in
presence of finely-divided lead:—Linseed, 14 to 15.5 per
cent; nut, 7.5 to 8.5; cotton, 5 to 6; beech-nut, 4 to 5 per
cent. The non-drying oils give an increase of weight
from 1 to 3 per cent, and it is only after the lapse of some
months that we find an increase of 4 to 5 per cent.

**The Precipitation of Ferric and Aluminium Phos-
phate along with Calcium Sulphate.**—C. Taquet.—
The author dissolved 250 grammes superphosphate in
dilute hydrochloric acid. He evaporated to dryness
without calcination, and re-dissolved the mass in boiling
water, and added to the filtrate a concentrated solution
of pure and neutral potassium sulphate. An abundant
precipitate of a yellowish white colour was at once pro-
duced. This precipitate was found to consist of 18 per
cent ferric and aluminium phosphate, along with 80 per
cent calcium sulphate. On the other hand, the author
prepared some pure ferric phosphate, dissolved it in a
minimum of hydrochloric acid, and added potassium sul-
phate. No precipitate was produced. Hence it follows
that the phosphates are carried down by the calcium
sulphate.

Bulletin de la Société Chimique de Paris.
No. 6, March 20, 1883.

Notice on the Atomic Weights.—A. Butlerow.—
Inserted in full.

**Study on the Combustion of Explosive Gaseous
Mixtures.**—MM. Mallard and Le Chatellier.—Already
noticed.

**Thermometric Measurements and the Determina-
tion of the Melting- and Boiling-Points.**—J. M.
Crafts.—Already noticed under back volumes of the
Comptes Rendus.

**Appearance of Nitrous Acid in the Evaporation
of Water.**—A. Scheuer-Kestner.—The author, referring

to Mr. Warrington's note on this subject, points out that
the fact was put on record by Schœnbein many years ago
(*Répertoire de Chimie Pure*, vol. v., p. 190, 1863).

Atomic Weight of Didymium.—P. T. Cléve.—The
author obtains as a mean result $Di = 142.124 \pm 0.0326$.
This number deviates notably from the higher atomic
weights obtained by many chemists, and especially from
the figure 147, as found by the author in 1874, but these
higher results are explained by the unsuspected presence
of samarium, an element then unknown.

MEETINGS FOR THE WEEK.

- MONDAY, April 30.—Medical, 8.30.
— Royal Institution, 3. "Physiological Discovery,"
by Prof. McKendrick.
— Society of Arts, 8. Cantor Lectures. "The Trans-
mission of Energy," by Osborne Reynolds, F.R.S.
TUESDAY, May 1st.—Institution of Civil Engineers, 8.
— Pathological, 8.30.
— Royal Institution, 2. Annual Meeting.
WEDNESDAY, 2nd.—Society of Arts, 8. "Electricity as a Motive
Power," Prof. George Forbes.
THURSDAY, 3rd.—Royal Institution, 3. "Count Rumford," by Prof.
Tyndall.
— Society of Arts, 8. "A New Process for the Sepa-
ration and-Recovery of the Volatile Constituents
of Coal," by Mr. T. B. Lightfoot.
— Chemical, 8. "A New Oxide of Tellurium.—Tel-
lurium Sulphoxide.—A New Reaction of Tellu-
rium Compounds," by E. Divers, M.D., and M.
Shimose. "A Simple Modification of theordi-
nary Method for Effecting the Combustion of
Volatile Liquids by Glaser's Method with Open
Tubes," by Mr. Watson Smith. "On Acenaph-
thene," by W. R. Hodgkinson, Ph.D.
FRIDAY, 4th.—Royal Institution, 8. "Weather Knowledge in 1883,"
by Mr. R. H. Scott, at 9.
Geologists' Association, 8.
SATURDAY, 5th.—Royal Institution, 3. "Geographical Evolution,"
by Mr. A. Geikie.

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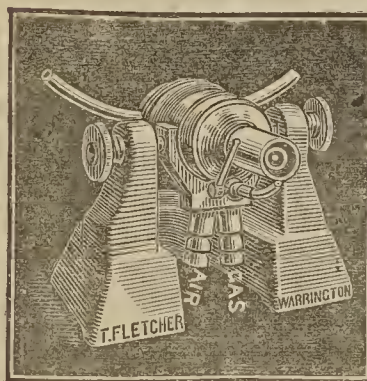
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1223.

CONTRIBUTIONS TO THE CHEMISTRY OF FOOD.*

By JAMES BELL, Ph.D., F.C.S.

THIS paper contains the results of researches on butter, cheese, milk, the cereal foods, bread, and lentil flour.

The author some time ago, as the result of a series of experiments, indicated that it was probable the soluble and insoluble fatty acids in butter-fat did not exist as simple glycerides, but in the complex form of compound ethers—palmitic and oleic acids being combined in the same molecule with butyric acid. The results of a further investigation into the character of butter-fat are given, which tend to confirm this theory of its constitution. Butter-fat is proved to vary in composition far beyond the limits previously supposed, and a table of representative samples is given, showing the ordinary variations which occur. Ordinary fats are contrasted with butter-fat, and it is suggested that the latter, from its complex character, probably performs some more specific office in the system than the former.

The proximate analyses of ten descriptions of cheese are given, and the composition of the fat extracted has been determined in each case. The soluble and insoluble fatty acids are shown to possess the normal relation existing between these acids in milk-fat, a result held to be inconsistent with the views advanced by some chemists that the albumenoids become slowly changed into fat.

Tabular results are given of a wide and comprehensive investigation into the variations which occur in the composition of the milk yielded by different cows under the varying conditions of food and season. Besides cow's milk, the proximate constituents of other kinds of milk have been determined, and as the analyses of the whole of the milks have been conducted on an uniform method, the results will be found valuable for purposes of comparison.

The changes which occur in sour milk have been investigated and the results given, with a statement of the amount of depreciation which occurs in the non-fatty solids, according to the period for which the milk has been kept.

Tabular results are given of the proximate analyses of the different cereals, of wheat-flour, and of oatmeal, and also a complete analysis of the ash of each. The proximate constituents of the cereals, &c., have been partly determined on new lines, and partly by an improved method of analysis.

Judging from the variable results obtained by different chemists, the author suggests that the saccharine matter appears in some instances to have been overlooked, while in others it must have been determined in an aqueous extract of the cereals, without regard to the transformations which the soluble albumenoids produce in starch and other carbohydrates in presence of water.

The albumenoids of the cereals have been found to possess varying degrees of diastatic action in converting starch, rye standing at the top, and rice at the bottom of the scale.

Tabular results of the proximate analyses of aerated and home-made bread are given; the changes which occur in flour during the baking process have been studied, and the sugar present identified as maltose. The results of a

proximate analysis of lentil flour made on the same lines as the cereals are given, and also a complete analysis of the ash of lentils.

ON ELECTRICITY APPLIED TO EXPLOSIVE PURPOSES.*

By Sir FREDERICK A. ABEL, C.B., F.R.S., Hon. M. Inst. C.E

IN introducing the subject the Lecturer indicated the principal advantages which it had been early observed would result from a certain mode of firing explosive charges by electric current instead of by the ordinary fuzes, the best of which had inherent defects, greatly limiting their use for any but the simplest operations. He traced the history and development of electric firing from the crude experiments of Benjamin Franklin, about the year 1751, through the various stages in which frictional electricity, volta-induction apparatus, and magneto-electric machines had supplied the means of generating the current, the tendency of late years being to revert to a modified form of voltaic battery for one class of work, and to employ dynamo-electric machines for another class. The history and development of the low-tension, or wire-fuze, and of the various fuzes employed with electric currents of high-tension, were also discussed, and their relative advantages, defects, and performances were described.

The only sources of electricity which at present thoroughly fulfilled the conditions essential in the exploding agent for submarine mines, were constant voltaic batteries. They were simple of construction, comparatively inexpensive, required but little skill or labour in their production and repair, and very little attention to keep them in constant good working-order for long periods, and their action might be made quite independent of any operation to be performed at the last moment.

When first arrangements were devised for the application of electricity in the naval service to the firing of guns and so-called outrigger-charges, the voltaic pile recommended itself for its simplicity, the readiness with which it could be put together and kept in order by sailors, and the considerable power presented and maintained by it for a number of hours. Different forms of pile were devised at Woolwich for boat- and ship-use, the latter being of sufficient power to fire heavy broadsides by branch circuits, and to continue in a serviceable condition for twenty-four hours, when they could be replaced by fresh batteries, which had in the meantime been cleaned and built up by sailors.

The Daniell- and sand-batteries first used in conjunction with the high-tension fuze for submarine mining service were speedily replaced by a modification of the battery known as Walker's, which was after some time converted into a modified form of the Leclanché battery.

The importance of being able to ascertain by tests that the circuits leading to a mine, as well as the fuzes introduced into that circuit, were in proper order, very soon became manifest; and many instances were on record in the earlier days of submarine mining of the disappointing results attending the accidental disturbance of electric-firing arrangements, when proper means had not been known or provided for ascertaining whether the circuit was complete, or for localising any defect when discovered.

The testing of the Abel fuze, in which the bridge, or igniting and conducting composition, was a mixture of the copper phosphide and sulphide with potassium chlorate, was easy of accomplishment (by means of feeble currents of high tension), in proportion as the sulphide of copper predominated over the phosphide. Even the most sensitive might be thus tested with safety; but

* Abstract of a Paper read before the Royal Society, April 26, 1883

* Abstract of a Lecture delivered before the Institution of Civil Engineers on Thursday evening, April 19th, 1883.

when the necessity for repeated testing, or even for the passing of a signal through the fuze, arose, as in a permanent system of submarine mines, the case was different, this fuze being susceptible of considerable alterations in conductivity on being frequently submitted to even very feeble test-currents, and its accidental ignition, by such comparatively powerful test- or signal-currents, as might have to be employed, became so far possible as to create an uncertainty which was most undesirable.

Hence, and also because the priming in these fuzes was liable to some chemical change detrimental to its sensitiveness, unless thoroughly protected from access of moisture, another form of high-tension fuze, specially adapted for submarine mining service, was devised at Woolwich. This, though much less sensitive than the original Abel fuze, was sufficiently so for service requirements, while it presented great superiority over the latter in stability and uniformity of electric resistance; and, though not altogether unaffected by the long-continued transmission of test-currents through them, the efficiency of the fuze was not affected thereby.

Although high-tension fuzes presented decided advantages in point of convenience and efficiency over the earlier form of platinum-wire fuze, the requirements which arose, in elaborating thoroughly efficient permanent systems of defence by submarine mines, and the demand for a battery for use in ships which would remain practically constant for long periods, caused a very careful consideration of the relative advantages of the high- and low-tension systems of firing to result in favour of the employment of wire-fuzes for these services. In addition to the disadvantages pointed out there was an element of uncertainty, or possible danger, in the employment of high-tension fuzes, which, though fully eliminated by the adoption of voltaic batteries, in place of generators of high-tension electricity, might still occasionally constitute a source of danger, namely, the possibility of high-tension fuzes being accidentally exploded by currents induced in cables, with which they were connected, during the occurrence of thunderstorms or of less violent atmospheric electrical disturbances.

Experiment, and the results obtained in military service operations, had demonstrated that if insulated wires, immersed in water, buried in the earth, or even extended on the ground, were in sufficient proximity to one another, each cable being in circuit with a high-tension fuze and the earth, the explosion of any of the fuzes by a charge from a Leyden jar, or from a dynamo-electric machine of considerable power, might be attended by the simultaneous ignition of fuzes attached to adjacent cables, which were not connected with the source of electricity, but which become sufficiently charged by the inductive action of the transmitted current. It therefore appeared very possible that insulated cables extending to land- or submarine-mines, in which high-tension fuzes were enclosed, might become charged inductively during violent atmospheric electrical disturbances to such an extent as to lead to the accidental explosion of mines with which they were connected. In a Report by Von Ebner on the defence of Venice, Pola, and Lissa, by submarine mines, in 1866, he refers to the accidental explosion of one of a group of sixteen mines during a heavy thunderstorm, as well as to the explosion of some mines, by the direct charging of the cables, through the firing station having been struck by lightning. Two instances of the accidental explosion of tension fuzes, by the direct charging of overhead wires during lightning discharges, occurred in 1873 at Woolwich.

Subsequently an electric cable was laid out at Woolwich along the river-bank below low-water mark, and a tension fuze was attached to one extremity, the other being buried. About eleven months afterwards the fuze was exploded by a charge induced in the conductor during a very heavy thunderstorm.

In consequence of such difficulties as these experienced in the special application of the high-tension fuzes to

submarine purposes, the production of comparatively sensitive low-tension fuzes, of much greater uniformity of resistance than those employed in former years, was made the subject of an elaborate experimental investigation by the Lecturer. Different samples of comparatively thin wires, made from commercial platinum, showed very great variations in electrical conductivity. Very considerable differences in the amount of forging to which the metal, in the form of sponge, had been subjected, did not importantly affect either its specific gravity or its conductivity, and the fused metal had only a very slightly higher degree of conductivity than the same metal forged from the sponge. The conductivity of very fine wires could therefore be but slightly affected by physical differences in the metal, and the considerable differences in conductivity observed in different samples of platinum were therefore chiefly ascribable to variations in the degree of its purity. It appeared likely that definite alloys might furnish more uniform results than commercial platinum; experiments were therefore made with fine wires of German silver, and of the alloy of 66 of silver with 33 of platinum employed by Matthiessen for the reproduction of B. A. Standards of electrical resistance. Both were greatly superior to ordinary platinum in regard to the resistance opposed to the passage of a current; German silver was in its turn superior to the platinum-silver alloy; although the difference was only trifling in the small lengths of fine wire used in a fuze (0.25 inch), while the comparatively ready fusibility of the platinum-silver wire contributed, with other physical peculiarities of the two alloys, to reduce the fine German silver wire to about a level with it. Moreover, the latter did not resist the tendency to corrosive action exhibited by gunpowder, and other more readily explosive agents, which had to be placed in close contact with the wire-bridge in the construction of a fuze, while the platinum-silver was found to remain unaltered under corresponding conditions. Experiments having also been made with alloys of platinum with definite proportions of iridium, the metal with which it is chiefly associated, very fine wires of an alloy containing 10 per cent of iridium were eventually selected as decidedly the best materials for the production of wire-fuzes of comparatively high resistance and uniformity, this alloy being found decidedly superior in the latter respect, as well as in point of strength (and therefore of manageableness in the state of very fine wire, 0.001 in. in diameter), to the platinum-silver wire. The fuzes now used in military and submarine services were made with bridges of iridio-platinum wire, containing 10 per cent of the first-named metal.

The electrical gun-tubes in the Navy were fired by means of a specially arranged Leclanché battery, and branch circuits worked to the different guns: in broadside firing it was important that the wire-bridge of any one of the gun-tubes which was first fired should be instantaneously fused on the passage of the current, so as to cut this branch out of circuit; in this respect the comparatively fusible platinum-silver alloy appeared to present an advantage,—hence the naval electrical fuzes were made with bridges of that alloy. Uniformity of electrical resistance had become a matter of such high importance in the delicate arrangements connected with the system of submarine mines, as now perfected, that the very greatest care was bestowed upon the manufacture of service electric fuzes and detonators, which were in fact made, in all their details, with almost the precision bestowed upon delicate scientific instruments, and the successful production of which involved an attention to minutiae which would surprise a superficial observer.

One of the earliest applications of electricity to the explosion of gunpowder was the firing of guns upon proof at Woolwich by means of a Grove battery and a gun-tube, which was fired by a platinum-wire bridge, a shunt arrangement being used for directing the current successively into the distinct circuits connected with the guns to be proved. When the high-tension fuze had been devised, gun-tubes were made to which it was applied, and an ex-

ploder was arranged by Wheatstone, having a large number of shunts, so that as many as twenty-four guns might be brought into connection with the instrument, and successively fired by the depression of separate keys connected with each.

The firing of cannon, as time-signals, was an ancient practice in garrison-towns, but the regulation of the time of firing the gun, by electrical agency from a distance, appears first to have been accomplished in Edinburgh, where, since 1861, the time-gun had been fired by a mechanical arrangement, actuated by a clock, the time of which is controlled electrically by the mean time clock at the Royal Observatory on Calton Hill.

Shortly after the establishment of the Edinburgh time-gun, others were introduced at Newcastle, Sunderland, Shields, Glasgow, and Greenock. The firing of the gun was arranged for in various ways; in some instances it was effected either direct from the Observatory at Edinburgh, or from shorter distances, by means of Wheatstone's magneto-electric exploders. At present there were time-guns at West Hartlepool, Swansea, Tynemouth, Kendal, and Aldershot, which were fired electrically, either by currents direct from London, or by local batteries, which were thrown into circuit at the right moment by means of relays, controlled from St. Martin's-le-Grand.

About thirteen years ago the electrical firing of guns, especially for broadsides, was first introduced into the Navy, with the employment of the Abel high-tension gun-tube and voltaic piles. The gun-tubes then used were manufactured simply for the proof of cannon and for experimental artillery operations, and were of very simple and cheap construction. Experience proved them to be unfitted to withstand exposure to the very various climatic influences which they had to encounter in Her Majesty's ships, and in store in different parts of the world. The low-tension gun-tubes, having a bridge of very fine platinum-silver wire, surrounded by readily ignitable priming composition, was therefore adopted as much more suitable for our naval requirements.

The arrangements for broadsides or independent firing, and also for the firing of guns in turret-ships, had been very carefully and successfully elaborated in every detail, including the provision of a so-called drill or dummy electrical gun-tube, which was used for practice and re-fitted by well-instructed sailors. The firing-keys, and all other arrangements connected with electrical gun-firing, were specially designed to ensure safety and efficiency at the right moment.

The electric detonators for firing outrigger-torpedoes, or for other operations to be performed from open boats, corresponded, so far as the bridge was concerned, with the naval electric gun-tubes, and were fired with a specially-fitted Leclanché battery. These electric appliances were now distributed throughout the navy, and the men were kept, by instruction and periodical practice, well versed in their use.

The application of electricity to the explosion of submarine mines, for purposes of defence and attack, received some attention from the Russians during the Crimean War under the direction of Jacobi; thus a torpedo, arranged to be exploded electrically when coming into collision with a vessel, was discovered at Yeni-Kale, during the Kertsch expedition in 1855. Some arrangements were made by the British, at the conclusion of the war, to apply electricity to the explosion of large powder charges for the removal of sunken ships, &c., in Sebastopol and Cronstadt Harbours. In 1859, a system of submarine mines, to be fired through the agency of electricity by operators on shore, was arranged by Von Ebner for the defence of Venice, which, however, never came into practical operation. Early in 1860, Henley's large magneto-electric machine, with a supply of Abel fuses, and stout india-rubber bags, with fittings to resist water-pressure, were dispatched to China, for use in the Peiho River, but no application appeared to have been made of them. The subject of the utilisation of electricity for

purposes of defence, however, did not receive systematic investigation in England or other countries until some years afterwards, when the great importance of submarine mines, as engines of war, was demonstrated by the number of ships destroyed and injured during the war in America.

The application of electricity to the explosion of submarine mines was very limited during that war, but arrangements for its extensive employment were far advanced in the hands of both the Federals and Confederates at the close of the war, men of very high qualifications, such as Captain Maury, Mr. N. J. Holmes, and Captain McEvoy, having worked arduously and successfully at the subject.

The explosion of submerged powder-charges, by mechanical contrivances, either of self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp, by the Duke of Parma, and from that period to 1854 mechanical devices of more or less ingenious and practicable character had been from time to time applied, to some small extent, in different countries, for the explosion of torpedoes. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and had the machines used for the defence of the Baltic been of larger size (they only contained 8 or 9 lbs. of gunpowder), their presence would probably have proved very disastrous to some of the English ships which came into collision with and exploded them. Various mechanical devices for effecting the explosion of torpedoes by their collision with a ship were employed by the Americans, a few of which proved very effective. But although in point of simplicity and cost, a system of defence by means of mechanical torpedoes possessed decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment was attended by such considerable risk of accident to those at whose hands they received application that, under many circumstances which were likely to occur, they became almost as great a source of danger to friend as to foe.

The most important advantages secured by the application of electricity as an exploding agent of submarine mines were as follows:—They might be placed in position with absolute safety to the operators, and rendered active or passive at any moment from the shore; the waters which they were employed to defend were therefore never closed to friendly vessels until immediately before the approach of an enemy; they could be fixed at any depth beneath the surface (while mechanical torpedoes must be situated directly or nearly in the path of a passing ship), and they might be removed with as much safety as attended their application.

There were two distinct systems of applying electricity to the explosion of submarine mines. The most simple was that in which the explosion was made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore; such a system depended, however, for efficiency, on the experience, harmonious action, and constant vigilance of the operators at the exploding—and observing—stations, and was, moreover, entirely useless at night, and in any but clear weather.

The other, which might also be used in conjunction with the foregoing, was that of self-acting mines, exploded either by collision with the ship, whereby circuit was completed through the enclosed fuze, or by the vessel striking a circuit closer, whereupon either the mine, moored at some depth beneath, was at once fired, or the necessary signal was given to the operator shore.

Continental nations had followed in our footsteps, in providing themselves with equipments for defensive purposes by submarine mines, and the Danes, Swedes, and Norwegians had pursued the subject of submarine mines with special activity and success.

In the United States the subject of the utilisation of electricity as an exploding agent for war purposes was

being actively pursued, and important improvements in exploding instruments, electric fuzes, and other appliances had been made by Smith, Farmer, Hill, Striedinger, and others already mentioned, while no individual had contributed more importantly to the development of the service of submarine explosions than General Abbot, of the United States Engineers.

Illustrations of actual results capable of being produced in warfare, by submarine operations, had hitherto been very few; but of the moral effects of submarine mines there had already been abundant illustrations. In the war carried on for six years by the Empire of Brazil and the Republic of Uruguay and the Argentine Republic of Paraguay, the latter managed, by means of submarine mines, to keep at bay, for the whole period, the Brazilian fleet of fifteen ironclads and sixty other men-of-war. In the Russo-Turkish war, submarine mines and torpedoes were a source of continued apprehension; and the French naval superiority was paralysed, during the Franco-German war, by the existence, or reputed existence, of mines in the Elbe.

The application of electricity to the explosion of military mines, and to the demolition of works and buildings, had been of great importance in recent wars in expediting and facilitating the work of the military engineer. The rapidity with which guns, carriages, &c., were disabled and destroyed by a small party of men who landed after the silencing of the forts at Alexandria, illustrated the advantages of electrical exploding arrangements, combined with the great facility afforded for rapid operations by the power possessed of developing the most violent action of gun-cotton, dynamite, &c., through the agency of a detonator.

The application of electricity to the explosion of mines for land-defences during active war was not an easy operation, inasmuch as not only the preparation of the mines, but also the concealment of electric cables and all appliances from the enemy, entailed great difficulties, unless the necessary arrangements could have been made in ample time to prevent a knowledge of them reaching the enemy.

But few words need be said to recall to the minds of Civil Engineers the facilities which the employment of electricity to explosive purposes afforded for expediting the carrying out of many kinds of works in which they were immediately interested. Electrical blasting, especially in combination with rock-boring machines, had revolutionised the operation of tunnelling and driving of galleries; and, although in ordinary mining and quarrying operations the additional cost involved in the employment of fuzes, conductors, and the exploding machine was not unfrequently a serious consideration, there were, even in those directions, many occasions when the power of firing a number of shots simultaneously was of great importance. There was little doubt, moreover, that accidents in mining and quarrying would be considerably reduced in number, if electrical blasting were more frequently employed.

The conveniences presented by electric firing arrangements, under special circumstances, were interestingly illustrated by a novel proceeding at the launch of a large screw steamer at Kinghorn, in Scotland, which was recently accomplished by placing small charges of dynamite in the wedge blocks along the sides of the keel, and exploding them in pairs, hydraulic power being applied at the moment that the last wedge was shot away.

In the deepening of harbours and rivers, and in the removal of natural or artificial submerged obstructions, the advantages of electric firing were so obvious that extended reference to them was unnecessary.

A substitute for electrical firing, which had been applied with success to the practically simultaneous firing of several charges, consisted of a simple modification of the Bickford fuze, which, instead of burning slowly, flashed rapidly into flame throughout its length, and hence had received the name of instantaneous fuze, or lightning

fuze. The fuze burned at the rate of about 100 feet per second; it had the general appearance of the ordinary mining fuze, but was distinguished from the latter by a coloured external coating. Numerous lengths of this fuze were readily coupled up together, so as to form branches leading to different shot-holes, which might be ignited together, so as to fire the holes almost simultaneously. In the Navy this fuze was used as a means of firing small gun-cotton charges to be thrown by hand into boats when these engaged each other, the fuze being fired from the attacking boat by means of a small pistol, into the barrel of which the extremity was inserted.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING MARCH 31ST, 1883.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To the RIGHT HONOURABLE THE PRESIDENT OF THE
LOCAL GOVERNMENT BOARD.

April 9th, 1883.

SIR,—We submit herewith the results of our analyses of the 217 samples of water collected during the past month, on the several days and at the times indicated, from the filtered water reservoirs of the seven London water companies taking their supply from the Thames and the Lea.

It will be observed that we have on this occasion, with a view to future comparisons, collected our samples not as usual from the mains, but from the reservoirs of the several Companies, after the water has been filtered, but before its entry into the mains.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from March 1st to March 31st inclusive. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted for analysis.

Of the 217 samples of water submitted to examination, the whole without exception were clear, bright, and well filtered. In respect to freedom from colour, the condition of the waters was superior to that observed for many months past.

In respect to the proportion of organic matter, as indicated by the determinations of organic carbon, it is interesting to compare the results afforded by the past month's analyses with those obtained before and during the recent period of quite exceptional river floods. Confining attention to the five Companies taking their supply exclusively from the Thames, the average amount of organic carbon during the past month was 0.152 part in 100,000 parts of water; the average during the month of October, when the influence of the floods began to be felt, being 0.158 part. The average for the four months, preceding October and the floods, was 0.117 part; while the average for the four succeeding months, when the floods were at their highest, was 0.244 part,—this last

and highest average, corresponding to less than half a grain of organic matter per gallon of water, with a maximum in any individual sample, out of the 68 averaged, falling short of three-quarters of a grain.

We have the honour to remain, Sir,

Your obedient Servants,

WILLIAM CROOKES,

WILLIAM ODLING,

C. MEYMOTT TIDY.

PROCESS FOR THE RECOGNITION OF HYDROCYANIC, HYDROCHLORIC, HYDRIODIC, CHLORIC, BROMIC, IODIC, HYDRO- FERROCYANIC, AND HYDRO-FERRICYANIC ACIDS.

By A. LONGI.

THE substance under examination is dissolved in water and the solution acidulated with acetic acid. If insoluble in water it is heated to a boil with sodium carbonate, and the filtrate is acidified with acetic acid. After any hydrogen sulphide present is expelled, silver nitrate is added in slight excess, and a little nitric acid. The precipitate may contain silver cyanide, chloride, bromide, iodide, bromate, iodate, ferrocyanide, and ferricyanide. In the solution may be present silver chlorate, bromate (in part), and mercuric cyanide. The liquid A is separated from the precipitate B, and examined separately.

A. In the liquid hydrogen is liberated by means of zinc and a little sulphuric acid. Silver chlorate and bromate are reduced to the corresponding chloride and bromide, and both these, along with mercuric cyanide, to metallic silver and mercury, hydrogen cyanide, chloride, and bromide being formed. When the reaction is at an end the mixture is filtered, and the filtrate is divided into three parts.

The first part is tested for cyanogen with a ferric ferrous salt.

To the second part is added silver nitrate, which separates hydrocyanic, hydrochloric, and hydrobromic acids. The precipitate is washed and digested in ammonia of sp. gr. 0.998. If the liquid filtered from the precipitate gives with nitric acid a white precipitate, insoluble in concentrated boiling nitric acid, chloric acid was present.

The third portion is tested for bromine with carbon disulphide. The presence of bromine shows that the original substance contained bromic acid.

B. The precipitate is carefully washed, and then digested in ammonia of sp. gr. 0.998. The cyanide, chloride, bromate, iodate, and ferricyanide are dissolved, but not the bromide, iodide, and ferrocyanide.

The residue is washed and treated with a solution of hydrogen sulphide to which a little hydrochloric acid has been added. It is heated to expel excess of hydrogen sulphide, and filtered.

The filtrate is tested for hydrogen ferrocyanide with a ferric-ferrous salt. Any ferrocyanide formed is filtered off, and the filtrate is tested for bromine and iodine with carbon disulphide.

The ammoniacal solution, which may contain cyanide, chloride, bromate, iodate, and ferricyanide, is treated with sulphurous anhydride. Cyanide and chloride are separated out; bromate, iodate, and ferricyanide are reduced to bromide, iodide, and ferrocyanide, and thrown down as such. The precipitate is washed by decantation and digested in ammonia. The cyanide and chloride are re-dissolved, but not the bromide, iodide, and ferrocyanide. The mixture is filtered. The solid matter is tested for bromine, iodine, and hydrogen ferrocyanide as above directed. Their presence shows that the

original substance contained bromic and iodic acids and hydrogen ferricyanide.

To the liquid is added nitric acid, by which cyanide and chloride are re-precipitated. The precipitate is divided into two parts. The one is treated with a little dilute hydrochloric acid, and filtered. The filtrate is tested for hydrogen cyanide with a ferric-ferrous salt. The other portion is heated to a boil with concentrated nitric acid. Cyanide is thus converted into nitrate, whilst chloride remains unchanged.—*Gazzetta Chimica*.

ON THE ELECTROLYTIC BEHAVIOUR OF THALLIUM, INDIUM, VANADIUM, PALLADIUM, MOLYBDENUM, SELENIUM, AND TELLURIUM. By L. SCHUCHT.

THALLIUM is not deposited under the influence of the current from a solution of the sulphate or nitrate containing free acid. The precipitation from a neutral solution is also incomplete in consequence of the liberation of acid.

From the ammoniacal solution of the same metal lead-grey metallic thallium is deposited at the negative electrode with a strong escape of gas, and blackish brown thallium oxide at the positive electrode. The result is the same in a solution of thallium supersaturated with potassa. From alkaline solutions the precipitation is complete.

Indium is deposited as a bluish white metal at the negative electrode, on submitting the sulphate to electrolysis. With solutions containing organic acids, indium is also deposited in a firmly adherent state, with abundant escape of gas.

On the electrolysis of vanadium chloride, dissolved in water containing hydrochloric acid, there was no precipitation. The blue colour of the solution changed to green and violet, the vanadic acid being reduced to vanadous oxide.

A watery solution of palladious nitrate, acidified with a few drops of nitric acid, gave immediately on closing the circuit a bronze-coloured deposit at the negative pole, which gradually became darker as the precipitation proceeded, and finally appeared black. At the positive pole there appeared a slight deposit of oxide of a red colour. In alkaline solutions of palladious oxide the precipitation was considerably slower, and the oxide also appeared.

From an ammoniacal solution of molybdic acid, molybdenum is deposited as molybdous oxide. Coloured rings appear first at the negative pole, which become denser and assume a deep blue-black colour. The blue deposit which first appears is a molybdic molybdate; then follow the green oxide and the black molybdous oxide. The precipitation is accompanied by an abundant escape of gas, and is perfect, as is found by testing with phosphoric acid. The deposit adheres very firmly. In acid solutions there is no precipitation, and an imperfect one from solution of ammonium molybdate containing an excess of molybdic acid.

Selenium is deposited both from acid and alkaline solutions at the negative pole, at first as a light brownish red coating, which gradually becomes thicker and darker. In both cases the precipitation is complete. As the deposit does not adhere firmly to the platinum cone, Schucht proceeds as follows: he oxidises the selenium by boiling with nitric acid, and adds the solution of some salt, the metal of which is thrown down by the current in a solid form, and thus mediates a firmly adhesive deposit of selenium. He prefers for this purpose a solution of copper. The positive pole is covered with a dark coating, which dissolves in hydrochloric acid with a yellow colour. The author ascribes this precipitation to the action of hydrogen selenide.

Tellurium behaves similarly to selenium, but is much more easily reduced by electrolysis.—*Zeitschrift f. Anal. Chemie.*

TITRATION OF IRON WITH SODIUM HYPOSULPHITE.

By A. C. OUDEMANS, Jun., and A. E. HASWELL.

THE author proposes to determine iron in the acid solution of the chloride to which a little solution of copper sulphate and potassium sulphocyanide has been added, by dropping in a solution of sodium hyposulphite of known strength until the red colour of the iron sulphocyanide has disappeared, and determining the excess of hyposulphite by titrating back with iodine solution.

A. E. Haswell modifies this method so as to avoid the possibly disturbing separation of copper sulphocyanide, and to dispense with the back titration with iodine. According to his experiments the iodine-starch reaction often takes place too early, before all the hyposulphite has been converted into sodium tetrathionate. He explains this occurrence by the tendency of copper iodide to split up into cupreous iodide and free iodine, and thus produce a premature blue colouration, which after a time disappears again as the cuprous iodide re-combines with the free iodine to form the cupric iodide.

Haswell mixes the moderately acid solution of ferric chloride, in presence of a cupric salt, with a few drops of a dilute solution of sodium salicylate, and then reduces with sodium hyposulphite. The deep violet colour of the solution fades gradually and becomes colourless in presence of a very slight excess of the reducing agent. The excess of sodium hyposulphite is then oxidised with a dilute solution of sodium dichromate. The limit of the reduction is sharply marked by the faint violet colour which indicates the oxidation of a trace of the iron. It must be remembered that strong hydrochloric acid destroys the colour produced by salicylic acid in ferric chloride, which, however, is restored on moderate dilution with water.

For the execution of the method there are required—a solution of sodium hyposulphite, standardised by means of a solution of ferric chloride of known strength; a solution of potassium dichromate, about half the strength of the sodium hyposulphite; a solution of copper, prepared by dissolving 2 grammes cupric-ammonium chloride in 100 c.c. water; and a solution of sodium salicylate, containing about 5 grammes of the salt per litre.

Five or ten c.c. of the iron solution are measured into a small flask, slightly acidulated with hydrochloric acid, and mixed with 1 to 2 c.c. of the copper solution and a few drops of the sodium salicylate. If the colour resulting is not a pure violet, but of an olive-brown, the liquid is diluted with water and the hyposulphite is added until the liquid appears perfectly colourless on standing with the back to the window and looking through the flask at a sheet of white paper. It often happens that on adding more sodium salicylate a faint colouration reappears, but it is removed by a drop of hyposulphite. He then titrates back with the dichromate until a faint violet colouration appears.—*Zeitschrift f. Analytische Chemie.*

Differences of Reactional Aptitude of the Halogens in the Mixed Haloid Ethers.—L. Henry.—In a former note the author has studied the action of various reagents upon ethelenic chlorobromide. The present communication refers to ethylene chloro-iodide and bromo-iodide, which have been submitted to the same reactions as the chloro-bromide, in the midst of alcohol. He concludes that as regards reactional aptitude the difference between chlorine and bromine is greater than that between bromine and iodine.—*Comptes Rendus.*

COMMERCIAL ANALYSES.

THE following letter has been sent to the leading chemists in this country. We shall be glad to receive communications on the subject, either as general comments or as particular answers to the questions.

Zurich (Switzerland), April, 1883.

DEAR SIR.

The Committee of the German Society for the Promotion of Chemical Industry has resolved, upon a suggestion made by the representative of the chemical manure manufacturers, to submit to the next General Meeting of the Society the following proposal, viz.:—

“That steps may be taken for bringing about an international agreement concerning uniform analytical methods for estimating the commercial value of certain products.”

I have been honoured with the request to lay a report upon this matter before the Meeting, and for this purpose I take the liberty of addressing myself to you, to obtain the favour of your opinion thereon.

It will not be doubted that the confusion at present reigning in that matter is very awkward indeed. In the transactions between manufacturers and their buyers and sellers, unpleasant discussions or even lawsuits are frequently caused by the employment of different methods of sampling, or testing, or both—methods which must needs lead to differing results; and an appeal to a commercial analyst sometimes increases the confusion by the introduction of a third method. This would be avoided if all those concerned were agreed upon employing certain standards for sampling and testing the goods, the same specific gravity tables, and so forth.

It is, moreover, most desirable that the results of analysis should be expressed in an uniform manner. Mutual understanding is greatly impeded if, for instance, one party calculates phosphoric acid as such, the second as tricalcic phosphate, the third perhaps as monocalcic phosphate. The strength of soda-ash is expressed in a different way each in England, France, and Germany, and many other similar instances might be quoted. Not merely for commercial purposes, but also for comparing results of work, it would be most desirable to establish some such agreement. An English acid maker, who learns that his German neighbour consumes so much nitric acid at 36° Baumé for each cwt. of sulphuric acid, has no notion what that may mean in terms of 96 per cent nitrate of soda per 100 parts of sulphur, &c., &c.

A considerable portion of the German chemical manufacturers has taken steps for improving this state of affairs, at least within their own country. The chemical manure makers have agreed upon uniform and binding modes of testing, and the alkali trade is aiming at the same object by means of a “Manual for Alkali-, Potash-, and Ammonia-Works,” just published. The success already attained in this direction in Germany has been an encouragement to conceive the idea that the great advantage of uniform methods might be extended internationally, and it is just the object of the present communication to gather information about the possibility of realising this.

Nobody, of course, will overlook the difficulties standing in the way of such an agreement. Some of the countries concerned do not even possess suitably organised unions of chemical manufacturers, and international unions of such a character are altogether out of the question. Even if such existed, they would never succeed in compelling their members to employ certain methods, or even the same way of expressing the results, and still less would they be able to exert such a compulsion upon the buying and selling public and the commercial analysts. Nor can it be denied that great differences of opinion exist as to the value of many analytical methods, and that constantly new, if not always better, methods come to the fore. Hence a rigid, compulsory code, binding for ever, or even

for a long period, is not to be thought of. But, on the other hand, those go too far who for this reason deny the possibility, or even the desirability, of an agreement in this respect. Even in public matters no law can be made which embodies absolute truth and justice; in the long run, with changing circumstances, the best laws become unsuitable and must be changed; but nobody pretends that therefore we must do without laws altogether. Without laying too much stress upon this simile, it will be conceded that an agreement among the leading manufacturers and chemists of the great industrial countries upon the matters concerned, even though it would not either possess or claim absolute binding power, would be invested with sufficient authority to serve, in a large majority of cases, as a standard in the intercourse between buyers and sellers. It would soon become a regular practice to stipulate for those standards in contracts and sale notes, and they would be acknowledged as decisive in Courts of Law.

With this view I beg to lay the following questions before you, in the respectful hope of receiving as full an answer as possible, to be made use of, either with mention of name or otherwise, as you may wish, in my Report to the Meeting of German chemical manufacturers :—

1. Do you believe that an international agreement, concerning exact standards of *sampling* ores, raw products, and chemicals could be attained?
2. Do you believe that a similar agreement could be attained in the matter of *analytical methods*, and more particularly in which definite branches of industry?
3. Do you believe that in some definite branches of chemical industry an uniform international *way of expressing the results* could be agreed upon, and have you any specific proposals to make in this respect?
4. In case you should answer one or more of the above questions in the affirmative, what *organs* would you think suitable for establishing an international agreement?
5. Do you think that such agreements should be made for an indefinite time, or that their *revision*, evidently called for from time to time, should be from the first provided for by a periodical action of the just-mentioned organs?
6. In what *form* do you think that the results of such an agreement should be made accessible to the public?

Whatever your opinion may be upon these points, I shall consider it a special favour if you will impart it to me at your convenience, in order to make use of it in my official report.

I have the honour to be, dear Sir,
Yours most respectfully,

GEORGE LUNGE, Ph.D.,
Professor of Technical Chemistry at the
Federal Polytechnic School, Zurich.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, April 28th, 1883.

Prof. CLIFTON, President, in the Chair.

A PAPER "On Colour-Sensation," by Mr. H. R. TROOP, was read by Mr. WALTER BAILY, Secretary. The author showed that more than three colour-sensations were consistent with the theories of Maxwell and Helmholtz, and explained that four primary separate colour-sensations, in couples, served the theory as well as three. The author

gave reasons for the existence of a fifth sensation—that of white.

Mr. STANLEY mentioned that his father was colour-blind to green, and saw it as a brown. He considered partial colour-blindness very common.

Mr. LEWIS WRIGHT stated that he found in optical experiments a partial colour-blindness from time to time, and between one of his eyes and the other. He recommended the study of this partial and variable blindness to colours.

Prof. CLIFTON stated that he had found similar variations amongst his students, and considered that one in three were unfit for delicate optical experiments.

Sir JOHN CONROY exhibited a new photometer, which is a modification of Ritchie's; the white screens not meeting at an angle, but almost meeting, and one projecting a little beyond the other, so that the eye could see the outer side of one and a little of the inner side of the other, both visible surfaces being illuminated by the lights. The screens were enclosed in a blackened box.

Mr. WALTER BROWNE then read a paper "On the Causes and Consequences of Glacier Motion." After reviewing the various theories of glacier motion and criticising each, the author gave reasons for preferring that of Mr. Mosely, namely, expansion by heat. He showed that the regelation theory now commonly accepted appeared inadequate, inasmuch as it does not explain the state of flow at low temperatures.

Mr. STANLEY pointed out that Forbes in his work on Norway gives expansion as a cause of glacier motion.

Professor PERRY referred to the experiment of Mr. Bottomley—in which a wire weighted at the ends cuts its way through a block of ice—in support of the regelation theory.

Professor GUTHRIE described an experiment he had made of the same kind, using a copper wire and a silk cord of the same thickness equally weighted on the same block of ice. The wire cut through, but the silk did not.

Professor AYRTON explained this on the assumption that the wire conveyed heat from the air, and enabled the weighted wire to lower the temperature of the ice to the melting-point, whereas the silk could not do so without more pressure, that is, weight.

Mr. W. COFFIN referred to the ice houses of Lake Superior, where he had seen heavy iron implements lying on blocks of ice at a low temperature without sinking in. Sinking took place when the sun shone on the ice.

Professor G. FORBES said that below 40 feet in rock variations of temperature were imperceptible, and probably it was the same with ice.

Professor Macleod, Mr. G. R. Griffiths, Mr. W. Baily, and the President also took part in the discussion.

Professor FULLER then took the chair, and

Professor CLIFTON exhibited a new spectrometer of his design. In the spectrometer it is important that the axis round which the prism turns, and the axis round which the telescope turns, should not be inclined, and in the new instrument these axes are coincident. A single cone, turned very true, has the telescope piece, the circle, and prism plate fixed on it.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Tuesday, May 1, 1883.

WARREN DE LA RUE, Esq., M.A., D.C.L., F.R.S., Vice-President, in the Chair.

THE Annual Report of the Committee of Visitors for the year 1882, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The Real and Funded Property now amounts to above £85,400, entirely derived from the contributions and donations of the Members.

Thirty-five new Members paid their admission fees in 1882.

Sixty-three Lectures and twenty Evening Discourses were delivered in 1882.

The books and pamphlets presented in 1882 amounted to about 206 volumes, making, with 517 volumes (including periodicals bound) purchased by the Managers, a total of 723 volumes added to the Library in the year.

Thanks were voted to the President, Treasurer, and the Honorary Secretary, to the Committees of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year.

The following gentlemen were unanimously elected as Officers for the ensuing year:—

President—The Duke of Northumberland, D.C.L., LL.D.

Treasurer—George Busk, F.R.S.

Secretary—William Bowman, LL.D., F.R.S.

Managers—George Berkley, M.I.C.E.; Sir Frederick J. Bramwell, F.R.S.; Warren De la Rue, M.A., D.C.L., F.R.S.; Dyce Duckworth, M.D., F.R.C.P.; Edward Frankland, D.C.L., F.R.S.; Colonel James Augustus Grant, C.B., C.S.I., F.R.S.; Right Hon. the Lord Claud Hamilton, J.P.; William Huggins, D.C.L., F.R.S.; Sir Frederick Pollock, Bart., M.A.; Henry Pollock; The Hon. Rollo Russell, F.M.S.; The Marquis of Salisbury, K.G., M.A., F.R.S.; Sir William Siemens, D.C.L., LL.D., F.R.S.; William Spottiswoode, M.A., D.C.L., Pres. R.S.; Sir T. Spencer Wells, Bart., Hon. F.R.C.S. Eng.

Visitors.—John Birkett, F.L.S., F.R.C.S.; The Lord Brabazon; Charles James Busk; Arthur Herbert Church, M.A., F.C.S.; Frank Crisp, LL.B., B.A., F.L.S.; Henry Herbert Stephen Croft, M.A.; William Crookes, F.R.S.; George Howard Darwin, M.A., F.R.S.; Rear-Admiral Herbert De Kantzow, R.N.; Clinton T. Dent, F.R.C.S.; Rev. John Macnaught, M.A.; Sir Charles Henry Mills, Bart., M.P.; Hugo W. Müller, Ph.D., F.R.S.; Lachlan Mackintosh Rate, M.A.; John Bell Sedgwick, F.R.G.S.

NOTICES OF BOOKS.

Disease and Putrescent Air. By THOMAS ROWAN, Consulting Engineer. London: E. and F. N. Spon.

THAT the sanitary arrangements adopted in large towns are at the present day a disgrace to the age and to the pretensions of those so-called engineers who make such matters their speciality is a fact that cannot be denied. In the construction of many of the palatial mansions in crowded cities—such, for instance, as London—it would seem to be the motto of the architect, with regard to sanitary matters, that out of sight is out of existence, and consequently that the easiest way of hiding or getting rid of refuse is, perhaps, by being the most economical so far as first cost is concerned, also the best. In this manner things are arranged for us until some innocent occupier of a tinselled shell is suddenly awakened to the fact that his drains have been constructed in a way not fit to keep a cow-house in a wholesome condition, by the outbreak of some vile form of zymotic disease in his household. Then, at the expense of much trouble and money, these hot-beds of contagium are patched up for him in such a way that they may not, at least for a while, offend his sense of smell. That this state of matters, of such vital importance to humanity, general and special, should exist, and consequently demand the adoption of stringent means for mitigating the evil, is rapidly impressing itself on scientific men, and there are many conscientious writers and experimenters who have, and are, devoting much labour to this branch of sanitation in devising effective methods for diminishing the deleterious action that a huge network of sewers in the midst of a densely populated district necessarily has. Still, where so much empiricism exists, and

when the very mention of “sewer-gas” causes consternation, quackery is of necessity sure to flourish luxuriantly.

Whatever may assist in opening the eyes of corporations, building contractors, and others to the necessity of having as perfect a system of sewerage as possible is acceptable, and with this aim we presume the pamphlet before us was written in the hope that it may be found “in some small degree to promote the cause of sanitary science.”

After skimming over the subject of disease and putrescent air, the author submits a process for the ventilation of sewers by downward and upward currents of air on what he terms the “intermittent system.” “The object of this system is to sub-divide the sewer into sections so as to ensure its thorough ventilation; each abstractor drawing from the inlets on either side of it, and the inlets consequently delivering air to the sewer in both directions.” This plan, however feasible on paper, has yet to be tested on a working scale in order to see how far natural circumstances affect the efficiency of the method.

From the general tone of the pamphlet we judge that it is the author's opinion that the thorough ventilation of a sewer, *i.e.*, causing a current of “pure” air to pass through it, is at least one of the best preventives against contagium from this source. This may, it is true, keep us ignorant of the presence of drains so far as our sense of smell goes, by diluting or sweeping out the offensive odours, carrying with them large quantities of suspended matter in which doubtless the true seat of disease lies, but it does not seem to us that mere ventilation will diminish the risks of the householder to the influence of putrescent organic matter that would still find its way from the drains into the dwelling through the defective arrangements employed to carry the refuse to the main sewer.

OBITUARY.

CHARLES HERBERT HUTCHINSON.

WE regret to announce the death, at the early age of 24, of Mr. Charles Herbert Hutchinson. Mr. Hutchinson received his scientific education in the Laboratories of the Pharmaceutical Society, where he studied from 1874 to 1877, and afterwards in the Laboratories of Professor Fresenius, at Wiesbaden. His skilful manipulation, scrupulous neatness, and, above all, his love for scientific work, won for him the admiration and interest of his teachers. While in the laboratories of the Pharmaceutical Society, Mr. Hutchinson published, in conjunction with Mr. R. H. Davies, the results of an investigation into the “Chemical Constituents of Ivy Berries” (*Pharm. Journ.*, [3], vii., 275). Upon his return from Germany he occupied for a short time the position of Assistant-curator of the Pharmaceutical Society's Museum, in order to obtain an acquaintance with medicinal plants. At this time he made a chemical examination of the plant *Myrtus Chekan*, the results of which were published in the *Pharmaceutical Journal* ([3], ix., 653). Soon after, Mr. Hutchinson became assistant to Prof. Armstrong at the London Institution and at the City and Guilds of London Institute, in Cowper Street. In April, 1879, he was elected a Fellow of the Chemical Society, and in the year following decided to turn his attention to brewing, and with this object he studied at Burton-on-Trent, and afterwards at Strassburg, finally becoming proprietor of a brewery in Essex. Mr. Hutchinson was a prominent member of the School of Pharmacy Students Association. In 1877 and again in 1878 he occupied the position of Vice-President, and for four years fulfilled the duties of Reporter upon inorganic chemistry. His reports were always looked forward to with great interest, for he had the power, far from common, of condensing long papers, embodying the

results of important researches, into *resumés* at once lucid and concise. Many of these were published in the *Pharmaceutical Journal*, and have since been the subject of much favourable comment. The following are some of the more noteworthy:—"The Formulæ of some Inorganic Substances" (embodying the researches of Meyer, Crafts, &c., upon vapour-densities at high temperatures), *Pharm. Journ.*, x., 841, and xi., 141; "Berthelot and Ditte's Researches upon the Hydrochlorides of the Metallic Chlorides" (*Ibid.*, xi., 1053); "Soxhlet's Researches upon the Estimation of the Sugars" (*Ibid.*, xi., 720, 757); "Quantitative Electrolytic Analysis" (*Ibid.*, xii., 715). At a largely attended meeting of the School of Pharmacy Students' Association on April 26 the following resolution was moved by Dr. Senier, seconded by the Honorary Secretary, Mr. Wyndham R. Dunstan, supported by many old members of the Association, and carried unanimously:—

"That the School of Pharmacy Students' Association hears with deep sorrow of the death of Mr. Charles Herbert Hutchinson, in whom the Association loses a former Vice-President and one of its most active and distinguished members, and that the members of the Association take this opportunity of expressing their sincere sympathy with the relatives of their late fellow-worker."

All who knew Mr. Hutchinson will feel that Science has lost an able and devoted worker.

CORRESPONDENCE.

ABSTRACTS OF CHEMICAL PAPERS.

To the Editor of the Chemical News.

SIR,—In the *Journal of the Chemical Society* of this month (April, 1883), abstracts of certain papers occur, and are acknowledged to their respective sources as follows:—

(1) "Novelties in the Iron Industry," by G. J. Snelus, G. L. Bell, and J. Gyers (*Ding. Polyt. Journ.*, 246, 433 to 438, 474 to 483, and 508 to 513).

(2) "Flameless Combustion," by Th. Fletcher (*Ding. Polyt. Journ.*, 246, 293 to 295).

(3) "Estimation of Coke and Volatile Products in Coal," by R. Galloway (*Chem. Centr.*, 1882, 767).

(4) Determination of Nitrites," by E. W. Davy (*Pharm. Journ. Trans.* [3], 13, 466 to 468).

The first title refers to papers read at the recent meeting of the Iron and Steel Institute in Austria, and the papers themselves are to be found in the *Journal* of the Institute.

The second title refers to a paper by Mr. Th. Fletcher, of Warrington, first read, I believe, at the recent *conversazione* of the Society of Chemical Industry, at Owens College, but, at any rate, first read in England and printed in English journals.

The subject of the third paper is a process for determining coke and volatile matter in coal, due to Mr. R. Galloway, of Dublin, and the description first appeared in a series of articles on analysis in the *Mechanical World*, a well known newspaper devoted to engineering, and published in Manchester.

The fourth heading refers to a paper read before the Royal Irish Academy by Dr. Edmund W. Davy on April 24, 1882, and no doubt to be found in the published *Transactions* or *Proceedings* of the Academy.

It seems a little curious that so excellent and valuable a *Journal* as that of the Chemical Society should depend for its reports of English papers upon abstracts in German chemical journals. If the abstracts are worth inserting it is surely better to take them first-hand, than for the information to filter through a foreign language. The authors' ideas are easier to reproduce from his own words than from an abstract in German. Perhaps, however, by the passage, they lose their dangerous properties, as

vaccine lymph is said to lose its dangerous properties by passing through a calf.

It is also easier when one wants to refer to the original to find it stated at once in the Society's *Journal*, than to have to refer, first to a German or other publication, and then back to the original. The Editor and Abstractor of the Society's *Journal* would add one more to the many services they render to chemists by keeping a sharper look out in English and Irish periodicals.—I am, &c.,

THOMAS BAYLEY.

Laboratory, 7, Broad Street, Birmingham,
April 30, 1883.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 15, April 9, 1883.

Report on the Electro-magnetic Machines applied to the Transmission of Mechanical Work by M. Marcel Deprez.—A very extensive report, drawn up by a select committee. The conclusions reached are to this effect:—The results obtained by M. Deprez, conformable in all respects to the theoretical principles by which engineers ought to be guided, far exceed all that had been done before him, both in the magnitude of the work transmitted as compared with the transmitting conductor, and, still more, in the mechanical yield obtained. The machine which he has designed and carried out presents notable improvements as compared with those previously constructed for the same purpose; it would probably have led to still more advantageous results if a similar one could have been constructed to act as a recipient.

Radiation of Silver at the Moment of its Solidification.—J. Violle.—At the Congress of Electricians in 1881, the author proposed as an absolute standard of light the radiation emitted by a square centimetre of melting platinum. He has since made certain experiments with silver. Liquid silver, at a temperature higher than its melting-point, being allowed to cool, it is observed at first that the radiation decreases more or less rapidly, according to the construction of the vessel containing the melted metal. The decrease slackens, and at the moment when solidification begins along the margin of the vessel, a small increase is produced. The liquid forms then in the midst of the solidified portion a kind of pool, the shores of which gradually advance, and during all this phase of the phenomenon the radiation of the liquid part remains constant. When the solidification reaches the centre there is a slight increase, followed by a rapid decrease. Silver yields thus a fixed secondary standard, which will be very useful in all spectro-photometric measurements, where the absolute intensity of the radiations is in general of little moment.

Several Optical Apparatus destined to Control Plane Surfaces, Parallel, Perpendicular, and Oblique.—L. Laurent.—This paper cannot be usefully reproduced without the three accompanying figures.

Powerful Direct-vision Spectroscope.—Ch. V. Zenger.—A combination of a parallelepipedon and a prism of crown glass, as shown in the diagram, gives a total dispersion equivalent to that of 13 to 14 prisms of carbon disulphide of 60°, an effect which is rarely attained by the most powerful spectroscopes.

Superior Limit of the Perceptibility of Sounds.—E. Pauchon.—When the pressure of steam within the box of Cagniard-Latour's syren varies from 0.5 to 1.5 atmospheres, the limit of perceptibility corresponds to sounds,

the height of which is comprised between 48,000 and 60,000 simple vibrations. On fitting the syren with a counter-plate the proportion between the pressure of the steam and the speed of rotation is constantly too great, and in the conditions of the experiment the limit of perceptibility cannot be reached, not even for the sound of 72,000 vibrations, the most acute which the author could produce.

Certain Experiments made with Dynamo-Electric Machines.—J. Pollard.—The results of the author's experiments are given in the form of a table.

Reply to M. Reynier's Observations on the Bichromate Battery.—M. Trouvé.—The author had sent a correction of his figures, but it arrived too late for insertion in the *Comptes Rendus*. The consumption of zinc for the twelve elements is 0.912 kilo.

Production of Crystalline Vanadates in the Dry Way.—A. Dilte.—The author has obtained barium, strontium, lead, zinc, cadmium, manganese, and nickel vanadates by utilising the decomposition of the apatites.

A Compound of Phosphoric Acid and of Silica.—P. Hautefeuille and J. Margottet.—The authors treat the silica obtained from the decomposition of silicon fluoride with water, and simply dried with meta-phosphoric acid in quiet fusion in a platinum crucible. The compound obtained consists of one molecule of each constituent. Its sp. gr. is 3.1, and it is hard enough to scratch glass.

Various Boro-Tungstates.—D. Klein.—The author has not succeeded in obtaining free boro-tungstic acid, but he has prepared the tri-barium, tri-potassium, and tri-silver salts, the sodium-barium and sodium-strontium compounds.

Difference of Reactional Aptitude of the Halogens in Mixed Halogenous Ethers.—L. Henry.—The author raises the following general question:—Given a multiple compound, containing, fixed upon a hydrocarbon residue, $C_n H_m$, radicles X, X', X'', of different natures, but functionally analogous or equivalent, and especially susceptible of being affected by one and the same foreign agent Y, in what proportion and in what successive order will these different radicles be attacked by the action of this foreign agent if presented in quantity insufficient to determine a total reaction, *i.e.*, to attack all the radicles indiscriminately and each of them completely? In answering this question he has first turned his attention to the ethelenic derivatives—



and the corresponding chloro-iodic and bromo-iodic compounds. He finds from his experiments that metallic reagents manifest an exclusive, or almost exclusive, preference for bromine in presence of ethylene chlorobromide.

MISCELLANEOUS.

Volatile Constituents of Coal.—On the evening of Thursday, April 26th, an interesting and important paper was read at the Society of Arts, on "A New Process for the Separation and Recovery of the Volatile Constituents of Coal," by Mr. T. B. Lightfoot, M. Inst. C.E., the chair being occupied by Sir Henry Hussey Vivian, Bart., M.P., F.G.S. The author, after pointing out the necessity that exists for some simple and economical method for recovering volatile products now almost universally lost in the coking of coal, and showing that in the pig-iron manufacture alone the money value of this waste amounts to about 5s. 6d. per ton of iron produced, proceeded to describe the process just recently invented and brought into use by Mr. J. Jameson, of Newcastle-on-Tyne. Though recovery ovens have been before coke-makers for some time, they had not met with any great degree of

favour in this country, chiefly owing to the expense attending their adoption, existing plant being entirely inapplicable; but in Jameson's process only a slight and inexpensive alteration is required, and it could therefore be at once applied to the whole of the present ovens, which are estimated to have a capacity of dealing with 20,000,000 tons of coal a year. If this were done the value of oil and ammonia so obtained would at existing prices be worth some £3,250,000, while a large amount of good heating gas, which taken at the extremely low price of 3d. per 1000 cubic feet, would come to £2,500,000, would also be made available. The author then drew attention to the applications of the recovered products, which, instead of blackening and defacing the surface of the country and destroying vegetation as at present, would give us solid paraffin and valuable illuminating and lubricating oils, for which we are now greatly dependent on the apparently failing supply of spring oil in America. Ammonia, also, which is much wanted for agricultural operations, as well as for many industrial purposes, would be produced in large quantities; indeed, it has been estimated from the experiments of Sir J. B. Lawes that if the ammonia from all the raw coal now burnt in this country was utilised in agriculture, we should add £50,000,000 worth of breadstuffs to our produce. With regard to the gas left after condensation of the volatile constituents, it was stated that it might be most beneficially used in gas-engines for the production of mechanical work, or electricity might be generated and conveyed for conversion into light and power. The author also thought that the gas might be most advantageously employed in manufactories for heating purposes in place of raw fuel, and also for cooking and heating in domestic houses. In conclusion, attention was drawn to the desirability, both on economic and sanitary grounds, of entirely doing away with raw coal as fuel, which could only be looked on as a relic of barbarism; and tables were given showing the saving that might be realised by the proper use of gaseous fuel and coke after the recovery of the more easily condensable constituents.

MEETINGS FOR THE WEEK

- MONDAY, May 7.—Medical, 8.30.
 — Royal Institution, 5. General Monthly Meeting.
 — Society of Chemical Industry, 8. "On Secondary Batteries, by Mr. C. T. Kingzett.
 — Society of Arts, 8. Cantor Lectures. "The Transmission of Energy," by Osborne Reynolds, F.R.S.
- TUESDAY, 8th.—Institution of Civil Engineers, 8.
 — Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
 — Royal Medical and Chirurgical, 8.30.
 — Photographic, 8.
- WEDNESDAY, 9th.—Society of Arts, 8. "English and Foreign Silver Work; with some Remarks on Hall Markings," by Wilfred Cripps, F.S.A.
 — Geological, 8.
 — Microscopical, 8.
- THURSDAY, 10th.—Royal Institution, 3. "Count Rumford," by Prof. Tyndall.
 — Royal, 4.30.
 — Royal Society Club, 6.30.
- FRIDAY, 11th.—Royal Institution, 8. "Oysters and the Oyster Question," Prof. Huxley, at 9.
 — Astronomical, 8.
 — Quckett Club, 8.
- SATURDAY, 12th.—Royal Institution, 3. "Geographical Evolution," by Mr. A. Geikie.
 — Physical, 3. "Measurement of Radiant Energy," by Capt. Abney, F.R.S. "An Experiment illustrating Motion Produced by Diffusion," by C. J. Woodward. "A Complete Determination of a Double Convex Lens by Measurements on the Optical Bench," by Prof. Clifton, F.R.S.

THE LONDON HOSPITAL and MEDICAL

COLLEGE, Mile End, E.—The Hospital contains nearly 800 beds, and is the largest general Hospital in Great Britain. The SUMMER SESSION commenced on MAY 1st. Students now entering can compete for the Entrance Scholarships in September. All Appointments are free to full Students. Special entries may be made for Medical and Surgical Practice, also for the Course of Practical Surgery.

MUNRO SCOT T, Warden.

THE CHEMICAL NEWS.

VOL. XLVII. No. 1224.

ON THE USE OF BROMINE IN TESTING FOR ALKALOIDS.

By C. L. BLOXAM.

If the alkaloids be dissolved in dilute hydrochloric acid, and tested with bromine water, the following reactions are observed:—

1. *Strychnine*.—A yellow precipitate, which is dissolved by boiling. If bromine water be added drop by drop, and the solution boiled between each addition, a fine violet colour is produced; the slightest excess of bromine bleaches it, but the colour returns on boiling.

2. *Brucine*.—A violet colour in the cold, followed by a yellow precipitate on adding more bromine.

3. *Narcotine*.—A copious yellow precipitate, even in weak solutions. If bromine water be added by degrees, and the solution boiled, a rose-pink colour is obtained, easily distinguished from the violet furnished by strychnine.

4. *Quinine* behaves like narcotine, but is not so easily precipitated by bromine water. If the quinine solution, after addition of excess of bromine, be covered with weak ammonia, the characteristic green colour is seen at the plane of junction of the liquids.

5. *Morphine* is not precipitated by bromine water unless the solution be rich in morphine. If an excess of bromine water be added, the solution boiled, a piece of zinc or tin introduced, the liquid again boiled for a minute or two, cooled, and weak ammonia poured in so as to float upon the surface of the liquid, a delicate pink band of colour is seen at the plane of junction, and is diffused through the liquid on shaking the tube.

6. *Cinchonine*, in strong solutions, gives a yellow precipitate with bromine water, but no characteristic reaction.

The following process of testing has enabled me to distinguish with certainty between the above alkaloids dissolved in large excess of dilute hydrochloric acid, and presented as unknown solutions:—

To the solution of the alkaloid in hydrochloric acid—

1. Add ammonia in *slight* excess. Precipitate: cinchonine, narcotine, quinine. Dissolved in large excess: quinine.

2. Add bromine water from the end of a glass rod. Violet colour: brucine. Yellow precipitate: *probably* strychnine or narcotine. Boil, and continue to add bromine water in very small portions, boiling after each addition—Violet colour: strychnine. Rose colour: narcotine or quinine. Add bromine water in excess, and boil; divide the solution into two parts—

(a) Cool, and float weak ammonia on the surface. Green colour: quinine. White precipitate: cinchonine or narcotine.

(b) Add a fragment of metallic zinc, boil for a minute or two, cool, and float weak ammonia on the surface. Pink colour: morphine.

Bromine water of convenient strength is made by shaking 30 drops of bromine with 8 ozs. of water.

I have not succeeded in obtaining in a pure state the fine colouring matter produced by brominating morphine and reducing with zinc or tin in hydrochloric solution. The colour is produced without addition of ammonia if the liquid be treated with excess of zinc; it is bleached by boiling, but returns on cooling; hydrochloric acid also bleaches it, but ammonia restores it.

King's College, London.

A LABORATORY FILTER-PRESS FOR RETAINING THE MOST FINELY-DIVIDED PRECIPITATES.

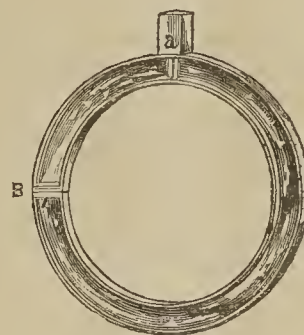
By JERVIS EYRE FOAKES.

It may be of some interest to those acquainted with the various apparatus for filtering, to learn the result of some experiments performed by a filter-press, constructed on what appears to be an entirely new principle.

With it several substances, whose nature has rendered them scarcely possible to filter by the ordinary process, have with the greatest ease been separated from the liquids in which they were suspended.

The apparatus consists of a solid flat glass ring (Fig. 1) 5 ins. in its internal, and 6 ins. in its external diameter; thus

FIG. 1.

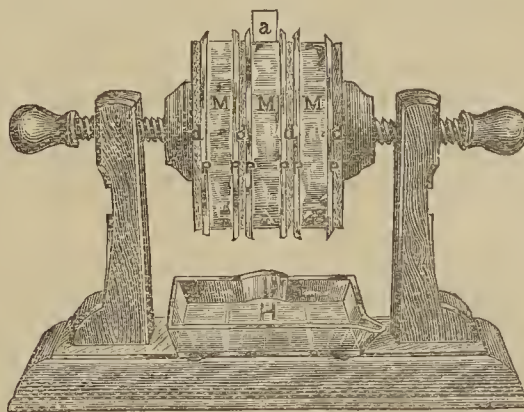


a, inlet; b, hole for the escape of air whilst the press is filling.

leaving a surface or band of $\frac{1}{2}$ in. on each side, which is ground perfectly even, and parallel to the opposite side. The breadth of the ring is generally about 1 in., but may be less, when the liquid contains little solid matter, and where the formation of a solid cake is not so much the object as quick filtration.

A diaphragm of plate glass 6 ins. in diameter, whose surface is covered by a filter-paper, or fine linen cloth, projecting about $\frac{1}{4}$ in. beyond the whole circumference, is placed on each side of the ring, the flat band of the ring pressing the paper or linen against the diaphragm.

FIG. 2.



m m, glass rings; d d, diaphragms; a, inlet for liquid to be filtered; p p, filter-papers.

The ring and diaphragms are then screwed tightly together in a wooden or iron stand by means of two screws having a flat disc of wood at their end. A series of rings with their corresponding diaphragms (Fig. 2) may be used instead of one; but in this case it is necessary that 3 or 4 holes be made through each diaphragm and its covering, to allow the liquid to pass into the adjacent ring, each hole being opposite to the one in the next diaphragm.

A tube is attached to the knob (a, Fig. 2) to admit the liquid to the interior of the rings, which is supplied con-

tinuously whilst the press is working by a pipe leading from a sufficient height to produce the necessary pressure, the amount of this pressure varying with the elasticity and fluid state of the substance to be dealt with.

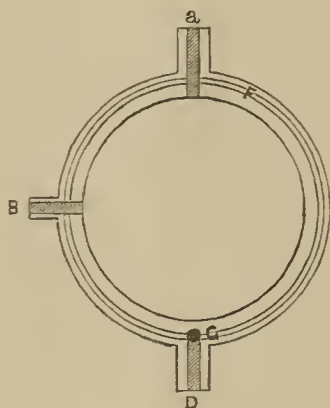
Directly pressure is applied filtration commences, all the insoluble matter being left in the hollow of the ring, or rings, whilst the soluble contained in the filtrate passes laterally, or radially, outward along the faces of the diaphragms to the circumference, and finally escapes, running down the outside of the press into a vessel (H, Fig. 2) placed beneath to receive it.

The flow from the press depends on the number of rings, their diameter, the kind of covering placed on the diaphragm, the pressure at which the liquid is supplied, and the nature of the substance under treatment.

Filtration is produced not only along the flat band of the ring, as might be imagined, but is evenly distributed over the surface of the filtering material; for, upon examination of the paper or cloth after the press has been working for a short time, it will be noticed that there is a deposit of equal thickness over the whole surface of that part of the covering which is exposed to the liquid inside the press.

Where it is of importance that the liquid should not be exposed to the action of the air during filtration, a groove (F, Fig. 3), $\frac{1}{4}$ in. in depth, is made in the flat band, and a hole (G, Fig. 3) is drilled through the rings, diaphragms, and the material with which they may be covered, connecting all the grooves in the series, with a single outlet (D, Fig. 3) at the bottom of the press.

FIG. 3.



For general use, where presses of large diameter are required, the ring is dispensed with, and its place is supplied by a buffing, or band of cotton, sewn round the edges of the diaphragms; the whole surface, including the buffing, being covered by the linen cloth. In cases of this kind the diaphragms are made of metal, or whatever material is best suited for contact with the body to be filtered.

Where large quantities of a fluid have to be passed through the press at high pressure, it is preferable to employ the direct action of steam rather than that of a force pump; for ordinary purposes a pressure from 10 lbs. to 60 lbs. to the square inch is sufficient, but this may if necessary be increased to as much as 120 lbs.

It is believed that this press has not till lately been applied to laboratory work, and it appears probable that by some slight alterations with regard to size and shape, it may become of great assistance in the collecting and washing of precipitates in quantitative analysis.

This press has been patented, and is known commercially as Bowing's filter-press.

With a small laboratory press, the following results were obtained in the laboratory of King's College. The ordinary filter papers were used, and in none of the experiments had the liquid to be passed through more than once.

I. *Barium Sulphate*—precipitated from a cold neutral solution; filtered to a clear liquid.

II. *Precipitated Sulphur* (without boiling)—filtered to a transparent liquid.

III. *Sulphide of Nickel*—prepared by precipitating nickel sulphide with excess of ammonium sulphide, producing a muddy brown liquid, which passes through an ordinary filter: filtered to a clear yellow.

IV. *Guaiacum Resin*—dissolved in alcohol, and a few drops added to a large proportion of water, yielding a milk-white solution: also filtered to a clear liquid.

V. *Faraday's Gold*—prepared by dissolving 1 grain of gold in *aqua regia*, evaporating to dryness, and adding a quart of water to the chloride obtained. On adding phosphorus dissolved in ether, and gently heating, or leaving the solution to stand for several hours, a deep colour is imparted to it. This colour has been shown to be entirely due to the presence of finely-divided gold suspended in the liquid.

If the flasks used in the preparation of this gold be carefully washed with distilled water to remove the last trace of saline matter, the liquid assumes a brilliant ruby-red colour, which may be changed to a deep purple or blue by stirring with a glass rod which has been previously dipped in a solution of common salt.

Faraday, speaking of the ruby gold, says: "The state of division of the particles must be very extreme; they have not as yet been seen by any power of the microscope."

The following coloured golds were filtered with the press to colourless liquids:—Purple, blue, and ruby-red. A portion of the last was also passed through an ordinary filter-funnel and paper ten times with hardly any perceptible alteration.

It is a remarkable fact that even with these difficult substances, should the filter-paper get torn whilst the press is in action, the filtering is in no way impaired unless the paper be damaged between the flat band of the ring and the diaphragm.

King's College Laboratory,
May 7, 1883.

METHOD FOR DETERMINING HYDROGEN CHLORIDE, BROMIDE, AND IODIDE IN SOLUTIONS CONTAINING HYDROGEN SULPHIDE.

By HALDOR TOPSÖE.

If a solution of hydrogen sulphide is gradually mixed with a moderately strong solution of potassium permanganate, previously acidified with a sufficiency of nitric acid, the liquid remains at first quite clear; a relatively small quantity of sulphur then separates out in the free state, and not until all the hydrogen sulphide is oxidised does the crimson colour of the permanganate appear. It vanishes again quickly, whilst brown manganese peroxide is deposited. The hydrogen sulphide, by the gradual addition of the oxidising agent, is converted into sulphuric acid, a comparatively small quantity of sulphur, and into traces of one of the lower oxides of sulphur, probably the hypsulphurous.

If, on the other hand, the solution of permanganate is added quickly, with stirring, and in such quantity that the liquid after the settlement of the hydrated peroxide retains a crimson colour, the hydrogen sulphide is completely oxidised to sulphuric acid. The result is unchanged if the solution of hydrogen sulphide contains hydrochloric acid or a metallic chloride, and what has already been said is in this case still applicable. If hydrobromic acid or a metallic bromide exists in the solution when the permanganate solution is continuously added, and the hydrogen sulphide entirely removed, the bromine is set at liberty. This completes the oxidation to sulphuric acid, even when not such a large excess of per-

manganate is present as is required if hydrogen sulphide is present alone or accompanied by a chloride. If hydriodic acid or a metallic iodide is present, the hydrogen sulphide is at once decomposed by the addition of the permanganate solution, which in this case must be used in a dilute state. Free sulphur is deposited, and the reaction is complete when the liquid assumes a slight yellowish brown colour from the iodine liberated.

After the hydrogen sulphide has been thus transformed or decomposed by the oxidation process, the liberated bromine or iodine may be converted into hydrogen compounds by means of aqueous sulphurous acid. In the same manner, or by means of oxalic acid, the manganese peroxide may be reduced to manganous compounds. A possible excess of sulphurous acid or oxalic acid is lastly removed by the cautious addition of a dilute solution of permanganate. The liquid contains then nothing which can interfere with the precipitation by silver nitrate.

The method thus indicated is applied as follows in the several cases:—Chlorine is determined in a liquid in which the existing hydrogen sulphide is, if possible, completely oxidised by the instantaneous addition of a large excess of permanganate, and thus converted into sulphuric acid. For every 100 c.c. of a solution of hydrogen sulphide saturated at common temperatures, at least 3.25 gramme potassium permanganate must be added along with at least 4 grammes nitric acid. But we generally have to do with a liquid from which a metallic sulphide has been precipitated by sulphuretted hydrogen, the precipitate has been filtered off, and washed. The liquid must therefore have lost a large proportion of the hydrogen sulphide with which it had been saturated. Hence the real consumption of permanganate is far smaller. The author finds by direct experiment that unless sulphuretted hydrogen water has been used for washing the precipitated sulphide, the oxidation can be completely effected by the application of 1.5 grammes permanganate per 100 c.c. of the original sulphuretted solution. But if the washing has been effected with sulphuretted hydrogen water the permanganate solution is added rapidly, with constant stirring, until the liquid becomes so deeply crimson as to be opaque.

After a sufficiency of permanganate has been added (preferably dissolved in 20 to 25 parts by weight of water, with 3 to 4 parts of strong nitric acid), the liquid is let stand for a few minutes, and a solution of oxalic acid is gradually added, stirring constantly. After the greater part of the sediment has been dissolved the acid is added only drop by drop till the liquid is completely clear. To remove an excess of oxalic acid (which is not easily avoided on account of the slowness with which it acts at common temperatures upon the manganese peroxide) the liquid is heated to 35°, and a dilute solution of permanganate is added till the liquid takes a faint pink tint. A single drop of oxalic acid solution removes this slight excess of permanganate.

An aqueous solution of sulphurous acid may also be used as reducing agent instead of oxalic acid, taking the same precautions to avoid and remove excess. In this case the proportion of sulphuric acid in the liquid will naturally be greater than when oxalic acid has been used.

If the sulphur has been thus completely oxidised to sulphuric acid, precipitation with silver nitrate can be at once undertaken after the treatment with oxalic acid or with sulphurous acid. If a small proportion of sulphur has been deposited it must first be removed by filtration.

For the determination of bromine the liquid in question is quickly mixed with a strong solution of permanganate (1 part in 20 to 25 parts of water with 3 to 4 parts strong nitric acid), stirring continually, until the liquid smells of bromine. The oxidation is then complete, and the liquid after treatment with sulphurous acid can be directly precipitated with silver nitrate. The sulphurous acid is cautiously added till the sediment of manganese peroxide is re-dissolved, removing excess in the manner already laid down under chlorine.

For the determination of iodine a dilute solution of permanganate (1 part to 50 of water and 1.5 to 2 of nitric acid) is added until the liquid takes a faint brownish yellow colour from the liberation of iodine. No manganese peroxide is precipitated. The sulphur is entirely deposited in the free state, and is removed by filtration after the liquid has been decolourised by means of a few drops of aqueous sulphuric acid. The iodine is then precipitated with silver nitrate in the ordinary manner.—*Zeitschrift für Analytische Chemie*.

SPECTRAL RESEARCHES ON SCANDIUM, YTTERBIUM, ERBIUM, AND THULIUM.

By TH. THALEN.

THE emission-spectra of scandium, ytterbium, and erbium were obtained by means of a Rühmkorff, the spark of which was strengthened by the intercalation of two Leyden jars, and the electrodes were moistened with a solution of the chlorides of the metals. The most remarkable of these spectra is that of scandium. It presents a great number of lines of medium intensity in the orange and the indigo, whilst in the yellow, the green, and the blue portion there are a number of very fine but brilliant lines, forming several separate groups. The author gives the wave-lengths and intensities of different lines of the three metals in a set of tables. He has studied both the absorption- and emission-spectrum of thulium. The absorption-spectrum was examined with two solutions of nitrates, one of which was rich in erbium, and the other was almost colourless and rich in thulium. Two absorption-bands in the spectrum of thulium were distinguished by their breadth and intensity, whilst they are very faint in the erbium spectrum. The darker of the two is between the Fraunhofer's lines B and C (the middle being about $\lambda=6840$); the other is in the blue ($\lambda=4650$). In the emission-spectrum—for which again the solutions of the nitrates were employed—there are likewise two bands, one of which, broad and very brilliant, coincides with the darkest of the absorption bands. The other falls in the blue ($\lambda=4760$), and is wanting in the absorption-spectrum. There is no trace of the brilliant spectrum corresponding to the above-mentioned dark band ($\lambda=4650$), whilst it appears distinctly in the spectrum of erbium. It is hence doubtful if the absorption-band $\lambda=4650$ really belongs to thulium.—*Journal de Physique*.

ON THE SEPARATION OF MORPHINE IN CHEMICO-LEGAL INVESTIGATIONS.

By E. SCHEIBE.

THE author proposes the following method for all cases where the quantity to be separated is small:—

The comminuted portions of the body are repeatedly extracted with acidified water, urine and other liquids being previously concentrated by evaporation. The united extracts are filtered and evaporated on the water-bath almost down to the consistence of a syrup, and are then extracted with 4 to 5 volumes of alcohol at 95 per cent, and filtered. The filtrate is freed from alcohol by distillation: the residue in the retort is again filtered, and shaken up with amyl alcohol as long as colouring matter is removed. The acid liquid is then heated to 50° to 60°, an equal volume of amyl alcohol is added, the whole rendered alkaline with ammonia, and shaken up for some time. The amyl alcohol is separated from the aqueous fluid, and the shaking up is repeated with fresh portions of amyl alcohol. The extracts thus obtained are distilled, the residue evaporated to dryness, and repeatedly extracted at

a gentle heat with water slightly acidified. The acid filtrate is covered with a mixture of 10 parts anhydrous ether to 1 part of alcohol, rendered alkaline with ammonia, and shaken. This operation is repeated several times. In this manner, on the evaporation of the ethereal-alcoholic mixture the morphine is obtained free from all colouring matters which might otherwise mask the characteristic reactions.—*Chemiker Zeitung, Coethen, and Pharm. Zeit. Russlands.*

METHOD FOR DETERMINING HYDROCHLORIC, HYDROCYANIC, HYDRO- FERROCYANIC, AND SULPHOCYANIC ACIDS WHEN SIMULTANEOUSLY PRESENT.

By W. BORCHERS.

If hydrochloric, hydrocyanic, and hydro-sulphocyanic acids are present 10 to 20 grs. of the saline mixture are present, and the solution is diluted to a litre. In one portion of this liquid the total quantity of the three acids is ascertained by titration with silver solution. To another portion is added the exact quantity of the silver solution thus ascertained, and the precipitate is quickly filtered off. Washing is only required if the filtrate contains sulphates. The precipitate is not dried, but the funnel with its contents is set upon a small flask, the filter is perforated with a thin pointed glass rod, and the precipitate is washed down with nitric acid of 1.37° to 1.40° sp. gr. The contents of the flask are heated to a boil, and kept at this temperature till no more red fumes escape, adding more nitric acid if needed.

The undissolved portion of the precipitate contains all the chlorine in the form of silver chloride, which is separated by filtration. The filtrate contains silver sulphate equivalent to the sulphocyanide, and silver nitrate representing the cyanide. The sulphuric acid and the dissolved silver are therefore determined. The author finds it advisable to precipitate the sulphuric acid with barium nitrate, and to titrate the silver in the diluted filtrate partially neutralised with alkali.

The chlorine is found from the weight of the silver chloride, the sulpho-cyanogen from the sulphuric acid, and the cyanogen from the difference. The quantity of silver required to combine with the sulpho-cyanogen and cyanogen is found also by two other ways—by subtracting the quantity of silver calculated from the weighed precipitate of silver chloride from that necessary for precipitating all the acids, and, on the other hand, by direct titration of the silver dissolved by nitric acid.

If hydro-ferrocyanic acid is present along with the three others, the totality of the four acids is determined in one portion by titration with silver solution. If this is done on Volhard's method, the solution of ferric oxide used as indicator must not be added till after complete precipitation with silver solution, as otherwise a deposit of Prussian blue would take place. In a second portion the ferrocyanide is precipitated with an acid ferric salt free from chloride, the precipitate is filtered off, and the three other acids are determined as above.—*Zeitschrift für Analytische Chemie.*

Action of Sulphur upon the Alkaline Phosphates.
—MM. E. Filhol and Senderens.—At ordinary temperatures finely-divided sulphur has no action upon a solution of tri- or di-potassic phosphate. If the mixture is raised to 100° there is formed a notable quantity of alkaline polysulphide and hyposulphite. If the solution is tolerably concentrated the tri-sodium phosphate is transformed into the di-sodium salt in less than two hours. The reaction tends towards the formation of a sesqui-sodium phosphate. Phosphoric acid seems to be a sesqui-basic acid, of mixed functions.—*Comptes Rendus.*

DETERMINATION OF ORGANIC MATTER IN POTABLE WATER.*

SECOND PAPER.

By Prof. J. W. MALLET, F.R.S., University of Virginia.

ORIGIN AND CHARACTER OF THE RESEARCH.

At the close of the report on the extended investigation of the chemical methods heretofore in use for determining organic matter in potable water,† certain suggestions were made as to possible improvements in these methods, tending to remedy defects which had been discovered in the course of the research. By direction of the Executive Committee of the National Board of Health, given during the past summer, the most important of these suggested improvements have been practically studied, and the results are now reported upon.

COMBUSTION PROCESS.

Evaporation of the water under much diminished pressure, in a vessel excluding contact with the atmosphere.

The vacuum vessel was a tolerably stout glass jar, such as anatomical preparations are kept in, the mouth of which had been ground flat upon a plane surface, and was covered by a disk of thick plate glass, with two bluntly tapering holes drilled through it. A strip of thick, hard, sheet brass, having two holes in it corresponding to those in the glass disk, served to form a clamp by which this disk was firmly pressed down upon a ring of sheet india-rubber laid as a washer on the ground mouth of the jar. The holes were fitted with good, soft, india-rubber stoppers, through one of which passed a funnel, with well-ground glass stopcock, and tube of almost capillary bore, while through the other passed the glass tube, serving to carry off the vapour as formed, which tube was connected with the block-tin worm, surrounded by ice-water in the worm-tub, and delivered water as condensed into the stout bottle, from which the thick india-rubber tube led to the jet-pump serving to produce exhaustion. The vacuum vessel was supported above the bottom of a large glass beaker serving as a water-bath, and this in turn was supported on a sand-bath above a Bunsen gas-burner with "rose" top.

The specimen of water to be examined was evaporated in a glass dish of about 4 inches in diameter, placed at the bottom of the vacuum vessel. At first this dish was supported in an upright position by a brass ring, and only touched the glass of the outer vessel at one point at bottom; but it was soon found that with this arrangement the transmission of heat from the water-bath was quite too slow, and hence some mercury was placed in the bottom of the vacuum vessel, and the dish was immersed in this to a considerable part of its depth. The jar was about 6 inches deep, and of a diameter just sufficient to allow the glass dish to drop down easily, but I should prefer to diminish the depth, and would indeed rather use a simple glass dish, of stout glass, with turned-over lip ground to receive directly the india-rubber washer and plate-glass cover, thus dispensing with the separate vacuum chamber altogether, and leaving but a single thickness of glass between the water-bath and the water to be evaporated. As my apparatus was arranged, no inconvenience was experienced from vapour of mercury, but in long-continued use no doubt enough of this vapour would be given off under the reduced pressure to attack the block-tin worm and make it brittle.

Owing to the slow transmission of heat at the comparatively low temperature employed, the water-bath had to be considerably warmer than the water in the dish within. The bath had immersed in it a thermometer,

* Report on the results of a supplementary investigation, made by the direction of the National Board of Health. From *American Chemical Journal*, vol. iv., No. 6.

† See *CHEMICAL NEWS*, vol. xlv., p. 63

and was kept filled to the proper height by a constant-level feed. The worm-tub was filled with water at the outset, and afterwards fed with lumps of ice; an overflow tube served to carry off surplus water. If the apparatus were left at work during the night it would become necessary to supply ice-water to the condenser from a large reservoir by a constant-level feed-pipe.

It is desirable that the tubes, both of glass and of block-tin, through which the escaping vapour passes, should have an interior diameter of not less than a third of an inch.

In my experiments the water to be evaporated was introduced, about 50 c.c. at a time, by pouring into the wide portion of the funnel and very cautiously opening the stopcock. This funnel might, however, be replaced by an almost capillary tube with a glass stopcock upon it, connecting the vacuum chamber with the bottom of a flask containing the whole quantity of water to be evaporated, this flask being placed out of the reach of the heat from the lamp and water-bath: after the temperature and pressure within the apparatus have become approximately constant the stopcock might be set very partially open, so as to allow of continuous supply of more water at just the rate demanded by the progress of the evaporation. In any case the vacuum must be gradually and cautiously established at first, in order to avoid any spattering of the contents of the dish from the escape of bubbles of dissolved gases, and for the same reason each new portion of water must be introduced cautiously, not too much at a time. The stopcock on the inlet tube must be thoroughly well ground, so as to work and remain tight without any lubricant.

The vertical limb of the exit tube for the vapour should be as short as possible, to prevent any risk of liquid water condensing in it and dropping back into the dish, thus producing splashing, and with the same object in view this short vertical portion of the tube and the whole of the top of the glass covering plate are with advantage to be protected from cooling by some loose cotton-wool. The longer limb of the same exit tube should have a decided downward inclination, so as to prevent any condensed water running back.

Using mercury in the bottom of the vacuum chamber, it was heavy enough to rest steadily on its support; but if this were not the case, and there were a tendency to float up, a simple clamp could of course be used to hold the vessel firmly down.

During the greater part of my work the barometer was at something like 745 m.m., and the mercury in the jet-pump gauge stood at about 690 to 700 m.m. Entire freedom from any return of air or water through the pump, and from any abrupt oscillations of the gauge, was secured by an oiled-silk valve, opening only towards the pump, which was inserted in the line of tubing connecting the latter with the evaporation apparatus.

The temperature of the water-bath was so regulated as to keep the water in the glass dish very near, but distinctly below its boiling-point for this reduced pressure. The water was therefore evaporated at but little over 30° C., though the thermometer in the water-bath was at 55° or 60°. Of course actual boiling must not be permitted, as it would almost certainly lead to loss of water from the dish.

It was found possible to complete the evaporation of half a litre of water in this apparatus between daylight and dark on a long summer day—say within fifteen hours; but of course the rate of evaporation will depend much upon the more or less free consumption of water in running the jet-pump, so as to steadily maintain a high degree of exhaustion, and the same amount of water may be treated in less time if with higher pressure a higher temperature be permitted.

In order to test the advantage supposed to be obtainable from this method of evaporating water for the combustion process, organic matter had to be introduced in accurately known quantity, and for this purpose leucine

and tyrosine were selected, as representing the more stable products of putrefaction liable to occur in natural water, and for which nevertheless the combustion process in its usual form had been found to give results far from satisfactory. Eight experiments were made with each of these substances, using from 5 to 40 m.grms. per litre of water. The results of the sixteen combustions were as follows:—

TABLE I.

Amount obtained, as percentage on amount originally present.

			Greatest.	Least.	Average.
Leucine:—					
Carbon	.. ..	97.24	91.40	95.77	
Nitrogen	.. ..	95.64	88.27	93.32	
Tyrosine:—					
Carbon	.. ..	98.13	92.65	97.04	
Nitrogen	.. ..	97.29	90.45	95.72	

These figures show a marked improvement upon the results obtained with the same substances by Mr. Noyes, using the Frankland process in its usual form. There is a much nearer approach to the recovery of the quantities of carbon and nitrogen really present in the water as taken for analysis. The two elements are recovered in much more nearly the true proportion to each other. The error for each is in the same direction, that of partial loss, instead of there being a large excess of nitrogen. We may fairly conclude, therefore, that there is real advantage in evaporating the water at the low temperature made available by diminished pressure, and with exclusion of atmospheric air.

It is to be observed, however, that there is uniformly some loss, although to a comparatively small extent, so that even for analyses made under these favourable conditions it cannot be rightly claimed that the results represent the whole of the organic matter originally contained in the water. Moreover, it is probable that much of the organic matter occurring in natural waters, and it is certain that some of it, is of less stable character than the leucine and tyrosine experimented on, and for such less stable material larger losses may be expected.* And, furthermore, Frankland has found that simple evaporation with sulphurous acid, even at a temperature near 100° C., will not suffice to entirely decompose the carbonates of a natural water, but that active boiling of the water for at least a few seconds after the addition of sulphurous acid is necessary;† some injury to the organic matter may be done by such high temperature applied even for so short a time, though the mischief will probably be small. In the experiments just recorded, sulphurous acid, to the extent of about a third of the usual quantity, was added, but the water was not boiled, there being no carbonates present.

Evaporation of the water with magnesia, in order to remove ammonia existing as such or as ammoniacal salts.

Lechartier has advocated‡ the removal of ammonia by evaporation with magnesia, the determination in the residue of the nitrogen of organic matter and nitrates, a separate determination of the nitrates, and calculation of the organic nitrogen by difference. It was proposed in my general report to modify this plan by evaporating with magnesia so as to get rid of ammonia, reducing nitrates in the residue brought to a small volume, but not to dryness,—as directed by Frankland,—by addition of sulphurous acid with a drop of a solution of a ferrous salt and eva-

* It has been found by Dietzell (*Berichte d. Deutsch. Chem. Gesell.*, xv., 551) that during putrefaction very considerable quantities of free nitrogen may be evolved by the formation of nitrous acid and its reaction on leucine, primary amines, and ammonia.

† It might be worth trying whether the decomposition of carbonates could not be advantageously accomplished by some of the acid salts, such as the acid phosphate of calcium, magnesium, or sodium.

‡ *Comptes Rendus*, lxxxix., 231. *Ann. de Chim. et de Phys.*, [V.], xix., 257.

poration to dryness, and finally determining organic nitrogen only in the dry residue by combustion.

In investigating this use of magnesia, however, a difficulty was encountered which vitiates Lechartier's method as well as my proposed modification of it. He says that evaporation with magnesia at the temperature of the water-bath, while it completely expels ammonia, does not decompose organic substances, such as urea, and gives in proof of this assertion the results of some experiments, in all of which urea was the only organic substance present. This statement I am unable to verify. I have tried several forms of nitrogenous organic matter liable to occur among the products of putrefaction, and have found that at temperatures no higher than 40° to 50° C., magnesia in the presence of water slowly attacks them, evolving small amounts of ammonia, detectable by litmus-paper and paper moistened with the Nessler test solution.

The magnesia was prepared by careful ignition of pure magnesium carbonate, and was very carefully washed to free it from any possible trace of alkali. It was placed, with a few cubic centimetres of water and the organic substance to be experimented on, at the bottom of a short, wide test-tube, the mouth of which was closed by a cork, serving to suspend a strip of the moistened test-paper, and the lower part of the tube was then immersed in a water-bath kept at the required temperature.

Salts of the amines on being thus treated very naturally affected the test-paper at once, and even at common temperature.

Specimens of urea, both of natural and artificial origin, recently re-crystallised, gave the reactions of ammonia distinctly and in a very short time at 40° to 45° C. It is stated that the amic acids are not decomposed with evolution of ammonia even by boiling with solutions of the alkalies, but leucine treated as above described with magnesia at 50° C. gave the reactions of ammonia distinctly, though somewhat slowly. Tyrosine behaved in the same way; it seemed to be rather more stable.

Benzamide apparently resisted decomposition, at any rate for some minutes, at 55°, but signs of the ammonia reactions began to appear at 100°.

Hence it appears that magnesia cannot be relied upon to expel pre-existent ammonia only from an evaporated water, leaving nitrogenous organic substances untouched. The long-continued contact with the water as its dissolved contents become concentrated, even at the low temperature made available by lowering of pressure, must produce losses of organic nitrogen, which may very possibly be accompanied by loss of carbon from the same constituents.

It may, however, perhaps be the case that in waters containing relatively very large quantities of ammoniacal salts, the error due to the cause under notice would be less than that attributable to the dissociation of these salts, to an extent not accurately determinable, during the evaporation.

Reduction and removal of nitrates by evaporation of the water with hypo-phosphorous acid.

In the main report on this water-analysis investigation it was stated that some preliminary experiments made by myself had seemed to show that nitrates and nitrites may be completely reduced by evaporating to a small bulk with no great excess of phosphorous or hypo-phosphorous acid, guarding against the evolution of phosphuretted hydrogen by the low temperature employed, then adding magnesia in small excess and completing the evaporation, thus leaving the residue in a pulverulent instead of a sticky condition, easy of removal from the dish, and probably allowing of complete combustion without inconvenience from the final oxidation of the small excess of phosphite or hypo-phosphite, and without any wrapping up of carbon particles. It was suggested that this plan was deserving of being tested.

It has now been tested, and with satisfactory results so far as the experiments have gone. Solutions of tyrosine,

20 parts per million of water, to which 10 parts of nitrogen per million had been added in the form of potassium nitrate (72.2 parts of this salt), were evaporated with 2 to 5 c.c. of a moderately strong solution of hypo-phosphorous acid. The highly concentrated, but not yet dry, residues were carefully tested for the nitrate by means of brucine, and for nitrite by Griess's naphthylamine reaction, but negative results were obtained as to both. There was no darkening or other apparent indication of the tyrosine being attacked, and on adding magnesia in excess, as proposed, to residues from the evaporation of similarly treated solutions and completing the drying, the combustion in the Sprengel vacuum was carried out without any special difficulty. In a natural water the carbonates present would be decomposed by the hypo-phosphorous acid, and carbon dioxide would be expelled during the evaporation.

In applying this method, using magnesia to neutralise the excess of acid and to dry up the residue to a condition in which it can easily be removed from the dish and mixed with cupric oxide, care must of course be taken that the magnesia is thoroughly ignited before being used, that it is not exposed to any considerable extent to the air after it has been so prepared, that the evaporation is carried on in such a vacuum chamber as has been described, and that the dried residue is not for any needless length of time exposed to the atmosphere before introduction into the combustion tube. Neglect of these precautions would lead to absorption of carbon dioxide, and consequent vitiation of the results as far as carbon is concerned. To avoid, however, the difficulty which had been ascertained to exist, arising from the action of magnesia on nitrogenous organic matter, it was thought best to use barely enough magnesia to neutralise the excess of acid, and to complete the drying up with an addition of pure silica, prepared by ignition of silicic acid, itself made from silicon fluoride. With this modification of the plan proposed the combustion gave results for the carbon and nitrogen of the tyrosine as good as those obtained on the average from the solutions of this substance in pure water without additions.

The solution of hypo-phosphorous acid should be carefully guarded from the air, and its strength ascertained from time to time (in order to judge approximately of the quantity to be used), not by neutralisation, but by the reducing action upon a solution of mercuric chloride.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 3, 1883.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

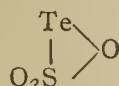
THE following certificates were read for the first time:—G. S. Bowler, A. Esilman, C. T. Heycock, H. Heap, W. J. Livingstone.

The SECRETARY then read a paper from Japan, "*On a New Oxide of Tellurium*," by E. DIVERS and M. SHIMOSÉ. When the compound of sulphur trioxide and tellurium, SO_3Te , which was prepared almost simultaneously by R. Weber and the authors of the present paper, is heated in vacuo, it decomposes between 180° and 230°, evolving sulphur dioxide, and forming a new oxide of tellurium, TeO . This oxide can be prepared in small quantity by the action of water on the sulphoxide. The oxide is black in colour with a slight brown shade, and shows, when pressed with a hard body, a graphitic lustre. It is quite stable in dry air at ordinary temperatures. Potassium hydrate has but little action upon this substance,

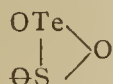
but it is readily decomposed by acids. No compound of TeO could be obtained, but the authors have specially compared this substance with a mixture of tellurium and tellurium dioxide, and find that its behaviour with chemical reagents is quite distinct from the reactions of the mixture.

Two papers by the same authors were also read:—

“*On Tellurium Sulphoxide*” The authors state that they had discovered this body before the arrival of the *Berichte* and the *Chemical Society's Journal*, which contained R. Weber's account of its formation. Their results are not, in some respects, quite in accord with those obtained by the above chemist. The tellurium was obtained from the mud in the lead chambers of the Imperial Japanese Sulphuric Acid Works, in Osaka. The liquid sulphur trioxide was poured on to the tellurium, both substances being contained in a sealed glass tube. The sulphur trioxide adhering to the sulphoxide was removed by heating the latter to 35° , and exhausting with a Sprengel pump, a long tube packed with borax being interposed to absorb the trioxide. The sulphoxide is a red amorphous solid, which softens without melting at about 30° . It is vesicular in structure, and, when pure, is quite stable, at ordinary temperatures, in sealed tubes. Details of the analyses are given. When this sulphoxide is heated to 90° in a vacuum, its colour changes to a bright fawn colour. No gas is evolved, and its composition remains unaltered. The authors suggest for the red variety the constitution—

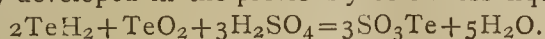


and for the brown—



Similar modifications of selenium sulphoxide seem to exist.

“*On a New Reaction of Tellurium Compounds.*” Sulphuric acid dissolves only small quantities of tellurium dioxide or its sulphate, but this solution furnishes a most delicate reaction for the presence of tellurium. By pouring some of it into a hydrogen apparatus containing zinc and dilute sulphuric acid, and passing the escaping hydrogen telluride through a second portion of the telluretted sulphuric acid, the red colour of tellurium sulphoxide is rapidly developed in the previously colourless liquid—



Dr. WILLIAMSON was strongly impressed with the care shown by the authors in this research and with the value of their results. The existence of this protoxide raised some interesting points bearing on theoretical questions. In the first place the evidence adduced by the authors of the difference between this oxide and a mixture of tellurium and dioxide seemed to him decisive in establishing its existence, but it was curious that the authors could not prepare any corresponding compound. Now, although it has generally been required that an oxide should have its corresponding chloride, &c., as a guarantee of its existence, yet it seemed that there was no reason why an oxide should not exist without a corresponding chloride, so that the non-discovery of the chloride must not be taken as a proof that the oxide did not exist.

The SECRETARY then read a paper “*On a Simple Modification of the Ordinary Method for Effecting the Combustion of Volatile Liquids in Glaser's Furnace with the Open Tube*,” by WATSON SMITH. The author, having observed that some of the students in the Chemical Laboratory of the Owens College were not able to make presentable analyses of a sample of chemically pure benzene when using Glaser's furnace, &c., devised this modification. The end of the combustion-tube containing the liquid in a bulb is made to project from the furnace; beyond the liquid is inserted a plug of oxidised copper. This plug is warmed by a Bunsen burner, and

thus the gas current is heated sufficiently to volatilise the liquid slowly and regularly. Two analyses of benzene and absolute ether are given; the results closely approximate to the theoretical numbers.

Mr. G. BEILBY then read a paper “*On the Production of Ammonia from the Nitrogen of Minerals.*” In the present paper the author, who has worked at the distillation of coals and shales in connection with William Young for some years, gives the results obtained by distilling two shales—one a typical oil shale from Midlothian, the second a coal shale from Ayrshire. These shales were distilled (1) by the usual process of distilling at a low red heat; (2) at a low red heat in a current of steam; (3) at a low red heat in a current of steam, the residual coke being afterwards subjected to the prolonged action of steam at such a temperature that the whole or a large part of the carbon being consumed by the steam the nitrogen is liberated as ammonia. The soda-lime process was used for the determination of the nitrogen. The results are given in pounds of N per ton. No. 1 shale gave, with the first process, 2.70 lbs. of N as NH_3 in the watery distillate, and 1.20 lbs. in the coke. The nitrogen combined with carbon amounted to 8.88 lbs. in the coke. By using the second process, all the ammonia in the coke came over in the distillate, and 3.9 lbs. of N as NH_3 were found in the watery distillate, the N combined with carbon remaining untouched. In the third process, however, the N as NH_3 in the watery distillate amounted to 12.0 lbs.; the N combined amounted to only 0.78 lb. Similar results were obtained with No. 2 shale. In the third process, the carbon, steam, and temperature should be so adjusted that the reaction is $\text{C} + 2\text{H}_2\text{O} = \text{CO}_2 + 2\text{H}_2$.

In reply to Dr. ARMSTRONG, the author stated that the above improved process (No. 3) of distillation was very successful commercially, the results being startling. In one case a coal shale, which furnished only 18 lbs. of ammonium sulphate per ton, now yielded from 75 to 98 lbs. The whole of the nitrogen could not be economically obtained; much difficulty was met with in the fusion of the ash. If the coke was valuable, no one would dream of burning it away; the process was particularly useful with small and bad coal.

Mr. BEILBY also read a short paper “*On the Specific Gravity of Paraffin Wax, Solid, Liquid, and in Solution.*” The specimen melted at 38°C ; its sp. gr., solid at 21°C ., was 0.874; when dissolved at 21° in heavy paraffin oil, 0.7956. By taking the sp. gr. of fused samples at various temperatures, and continuing the curve thus obtained, the sp. gr. of fused paraffin at 21° would be 0.796.

The Society then adjourned to May 17, when Captain Abney will deliver a lecture on “*Photographic Action Studied Spectroscopically.*”

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, May 7, 1883.

GEORGE BUSK, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

THE following Vice-Presidents for the ensuing year were announced:—Sir Frederick J. Bramwell, F.R.S.; Warren de la Rue, M.A., D.C.L., F.R.S.; Sir Frederick Pollock, Bart., M.A.; The Marquis of Salisbury, K.G., M.A., F.R.S.; Sir William Siemens, D.C.L., LL.D., F.R.S.; William Spottiswoode, M.A., D.C.L., Pres. R.S.; George Busk, F.R.S., Treasurer; William Bowman, LL.D., F.R.S., Honorary Secretary.

W. Mitchell, Miss Orbell, and Martin Ridley Smith were elected Members of the Royal Institution.

John Tyndall, D.C.L., LL.D., F.R.S., was re-elected Professor of Natural Philosophy.

Two Candidates for Membership were proposed for election.

The Presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

NOTICES OF BOOKS.

Sound. By JOHN TYNDALL, D.C.L., LL.D., F.R.S. Fourth Edition, revised and augmented. London: Longmans and Co.

THIS book, like all that proceeds from the pen of its author, is characterised by admirable clearness. No one can profess to misunderstand its teachings. Amongst the numerous treatises on physical science it is also distinguished by its total freedom from any reference to examinations. But above all we must pronounce it valuable as being a successful attempt to expound its subject without mathematical formulæ. Any person who will take the trouble to read carefully through these nine lectures will make the "immovable truths of Acoustics" his own. A very commendable feature is the summary placed at the end of each lecture. It is, however, unnecessary to describe at length the arrangement and contents of a work which has already found such wide approval.

The principal additions to the present impression are the substance of the author's memoir on the action of free molecules upon radiant heat, and its conversion into sound; an explanation of the "soundless zones" observed by General Douane as surrounding the fog-signal stations on the coast of the United States; notices of the telephone, microphone, and phonograph, and accounts of the action upon sound of soap-bubbles filled respectively with hydrogen and nitrous oxide. The author's observations on fog-signalling have been enlarged and illustrated by means of maps, and a more complete account is given of aerial echoes where sound is thrown back, not from a solid body, but by a non-homogeneous atmosphere. The work, in short, is made complete in accordance with the most recent discoveries.

Destructive Distillation. A Manualette of the Paraffin, Coal, Tar, Rosin, Oil, and Kindred Industries. By E. J. MILLS, D.Sc., F.R.S. Second Edition. London: John Van Voorst.

WE have here a little work on a chemical subject which differs strikingly and favourably from the legion of handbooks and rudiments by which our patience is at times put to a severe test. Dr. Mills is here not reproducing matter which has been published twenty or fifty times before, and which is or should be known to every chemist or "chemistian." He is here giving information valuable not merely to students, but to manufacturers, managers, and, we hope, to intelligent workmen, and which has not been presented in a convenient and accessible form. It is no vain boast when the author says, in the Preface to his first edition, "This little book is the first to present, as a whole, the industry of destructive distillation." And though much of what is here conveyed is to be found scattered through scientific journals and transactions, there is also no little information communicated by practical men, and not hitherto published. Nor must we forget that Dr. Mills, in his capacity as "Young" Professor of Chemistry at the Anderson's College of Glasgow, has been personally engaged with researches in this important department of chemical industry.

In his Preface to the present edition the author refers to not a few capital improvements lately effected:—"The almost perfect transformation of the nitrogen of coal into ammonia and the nearly equally complete abolition of extraneous fuel in shale distilling are signal illustrations of the application of scientific skill to industry. In the

laboratory the composition of many tars, both natural and artificial, has been minutely investigated, and among other results fresh evidence has been obtained of the remarkable persistence of the nC_6 group in these products. As historical facts the yield of the American oil-wells is now declining, and new sources of benzol are in imperative request." The experimentalist has here, therefore, every inducement to extend and to persist in his researches. After some ably written general considerations on destructive distillation, its products, and its principles, the author proceeds to an account of the paraffin manufacture. Thence he passes to the treatment of coal-tar, which he characterises as a "high-temperature industry" and a "dehydrogenising process," the aromatic bodies obtained containing H_n less than the corresponding fatty bodies. Coal, he remarks, is in itself less hydrogenised than the Cannel and other shales worked for paraffin. Next we have an account of wood-tar and its accompanying products. The remarkable fact is here mentioned that much of the Russian wood-tar now in the market is adulterated with brown British naphtha.

After a brief notice of apple-tar and cork-tar, and an account of the resin oils of Virginia and of the Landes, we come to petroleum. A table showing the fluctuations in its price from 1859 to August last is suggestive. In the first-mentioned year it was worth 19.77 dollars per barrel; at the last date it had sunk to 0.54 dollar. But its lowest price, 0.52 dollar, was reached in 1861. The petroleum of Baku appears to yield much more benzol, toluol, and anthracene.

An Appendix contains the bibliography of the subject in all its branches, from 1593 down to the present day. The treatise, as a whole, cannot be too strongly recommended to all persons interested in destructive distillation in any of its forms.

Notes on the Detection of the Acids (Inorganic and Organic) usually met with in Analysis, for the Use of Laboratory Students. By J. WILLIAM JAMES, Ph.D., F.C.S. London: J. and A. Churchill.

THE continued appearance of elementary treatises on chemistry, systematic or analytical, suggests a few perplexing questions. How is it that treatises covering nearly the same ground, and having no distinctive features, can always find publishers, whilst works containing the records of original study and research are vainly offered round the "Row"? Why, if students are so numerous, is the number of chemical discoveries and inventions not greater than it is found to be at present? The stream of manuals, handbooks, and the like, has been at flood for some years. But we see no proofs, so far, that it has greatly fructified the soil. Dr. James, who is demonstrator and lecturer in the Mining School, Bristol, remarks, in his Preface, that "although there are numbers of books on qualitative analysis in which the detection of the metals is ably dwelt upon, yet the acids have received but little attention, so far as their recognition when mixed is concerned." This deficiency he proposes to supply in the work before us, which extends to nineteen pages, not very closely printed. For further information on the reactions of any individual acid the reader is referred to the treatises of Fresenius and Valentin.

We do not see that the directions given are open to objection, but sundry acids, not remarkably uncommon, have been omitted. Hence, in possible cases, the student may feel perplexed.

Liquid Hydrochlorates of Terebenthene.—Ph. Barbier.—The author has examined the liquid mono-hydrochlorate produced by the action of hydrochloric acid upon an alcoholic solution of terebenthene, and the liquid mono-hydrochlorate obtained by the action of gaseous hydrochloric acid upon dry terebenthene.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. xcvi., No. 15, April 9, 1883.

Application of the Phenomena of Supersaturation to the Theory of the Hardening of certain Cements.—H. Le Chatelier.—Not adapted for useful abstraction.

Pyro-sulphuryl Chloride.—D. Konowaloff.—The author undertakes to refute the assertion of M. Ogier (*Comptes Rendus*, March 5) that pyro-sulphuryl chloride possesses an anomalous vapour-density.

No. 16, April 16, 1883.

Combustion-heat of the Glycolates and the Law of Thermic Substitution-Constants.—A reply to the note by M. de Forcrand (*Comptes Rendus*, March 26, 1883).

Liquefaction of Oxygen and Nitrogen and Solidification of Carbon Disulphide and Alcohol.—S. Wroblewski and K. Olszewski.—Already given in full.

Researches on the Phosphates.—P. Hautefeuille and J. Margottet.—On treating the meta-phosphates with melted meta-phosphoric acid to which a progressively increasing quantity of tri-basic silver phosphate has been added, there are formed, not merely the pyro- and the ortho-phosphates, but the intermediate phosphates.

Artificial Hausmannite.—Alex. Gorgeu.—The author keeps manganese chloride for several hours in a state of fusion in an oxidising atmosphere charged with watery vapour. The product thus obtained presents the density, specific gravity, colour, and crystalline form of hausmannite.

Pyro-sulphuryl Chloride.—D. Konowaloff.—The author treats of the action of phosphoric anhydride upon sulphuric hydrochlorate, and of sulphuric anhydride upon sulphur chloride.

Researches on the Oil of Angelica of the Roots.—L. Naudin.—The author has obtained from this oil a terpene, which he names β -terebangelene, to distinguish it from the isomeric product extracted from the oil of angelica seed.

Synthesis of the Heavens and the Earth.—M. Moigno.—The author considers the ether as the original substance. A first group of atoms of ether forms hydrogen. All the other elements are formed of molecules of hydrogen in determinate number, and having their essential distribution. The molecule of each simple body is a multiple of the molecule of hydrogen. The law of Prout is a law of nature, and the divergencies found spring from errors of observation due to the difficulty of obtaining the elementary bodies in a state of absolute purity. He derives a confirmation of this idea as to the fundamental part played by hydrogen from the declaration of St. Peter and St. Clement that the heavens and the earth were formed of water.

Journal für Praktische Chemie.

New Series, Vol. xxvii, Nos. 2 and 3, 1883.

Tungsten Compounds.—Dr. G. von Knorre.—There exists only one potassium tungsten bronze, $K_2W_4O_{12}$, but there are two potassium sodium tungsten bronzes, which the author has examined. The acid lithium tungstates do not yield bronzes either on electrolysis or when reduced by hydrogen. If tin is allowed to act for a short time upon a fused mixture of 5 mols. lithium oxide and 12 mols. tungstic acid, there is formed a compound which contains a little lithium. The author has examined several sodium

tungstates, three of them new, but was unable to obtain the bitungstates described by Lefort. He has also examined the potassium and lithium salts. The meta-tungstates are formed when the acid tungstates are heated with water under pressure.

Diazo-Derivatives of Symmetric Tribrom-aniline.—Dr. H. Silberstein.—The author studies the action of nitrous acid upon tribrom-aniline, tribrom-diazo-benzol nitrate, the corresponding sulphate, the action of hydrochloric, hydrobromic, and hydriodic acids upon tribrom-diazo-benzol nitrate, tribrom-diazo-amido-benzol, dimethyl-amido-azo-tribrom-benzol, and methyl-phenyl-amido-azo-tribrom-benzol.

Researches on the Aluminates and Basic Haloid Salts of Barium, with Notes on Barytic Hydrate and the Haloid Salts of Barium.—Dr. Ernst Beckmann.—By the action of barium hydroxide upon an excess of aluminium hydroxide there is formed in the first place only soluble mono-barium aluminate, but on prolonged heating a small quantity of barium aluminate is formed. A soluble aluminate, composed of equal molecules of alumina and baryta, is also formed alone when alkaline mixtures are prepared from solutions of aluminium chloride and baryta water, avoiding an excess of the latter. The precipitates are hydrated alumina. Solution of baryta still attacks aluminium if a quantity of the latter equivalent to 1 mol. alumina has already entered into solution for each mol. baryta, whilst a separation of hydrated alumina, and, under certain circumstances, of insoluble barium aluminate, goes on.

The quantity of baryta present in solutions of barium aluminate can be approximately ascertained by neutralisation with an acid. The author has examined a mono-, di-, and a tri-barium aluminate, all well characterised. Of these the di-compound is distinguished by its power of crystallisation. Barytic hydrate is represented by the formula $Ba(OH)_2 \cdot 8H_2O$. Eight mols. of water escape at 75° , but the last is given off only on prolonged ignition in a current of hydrogen. Dried hydrate, $Ba(OH)_2$, and anhydrous baryta, as well as the di- and tri-barium aluminates, are only attacked by carbonic acid at high temperatures. Barium dinoxide is most rapidly formed from anhydrous baryta at a cherry-red heat. Barium chloride loses more than 1 mol. of water over sulphuric acid at common temperatures, and in a current of dry air at 75° it loses all its water. Barium bromide retains its second mol. of water completely at 75° , and does not begin to lose it below 100° . Barium iodide retains its second mol. of water at 125° .

Kyanmethine.—E. von Meyer.—The object of the author is to demonstrate that the analogy between kyanmethine and kyanethine extends to their chemical behaviour.

Biuret-dicyanimide.—F. Rasinski.—A new base obtained by melting acetyl-urea with guanidine carbonate.

Behaviour of Oxy-benzoic Acid with Caustic Baryta.—A. Klepl.—These two compounds react upon each other if 2 mols. oxy-benzoic acid are heated to 350° with 7 mols. caustic baryta. Phenol is formed almost in the theoretical proportion.

Bulletin de la Société Chimique de Paris.

No. 7, April 5, 1883.

Decomposition of Formic Acid by the Effluve.—L. Maquenne.—The products of the reaction are carbon dioxide, carbon monoxide, and hydrogen. There is no formation of resinous polymers.

Salts formed by Glycolic Acid.—R. de Forcrand.—Already noticed.

Action of Carbon Monoxide upon Watery Vapour.—L. Maquenne.—The oxide of carbon is, even at low temperatures, a more powerful reducing agent than hydrogen.

Swedish Correspondence: Action of Phosphorus Salt upon Various Oxides.—K. A. Wallroth.—The author has undertaken to isolate and to analyse the crystalline salts resulting from the action of phosphorus salt upon a great number of oxides. He states as a general conclusion that the atomicity of the metals exerts a very remarkable influence of the salts formed.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3e Série. Tome x., February, 1883.

Report presented by M. F. Le Blanc on behalf of the Committee of Chemical Arts, on the "Intensive Burners" of the Parisian Gas Company.

Report presented by M. F. Le Blanc on behalf of the Committee of Chemical Arts on the Intensive Burners for Recovery of Heat, of M. F. Siemens, of Dresden.—These papers cannot be re-produced without the accompanying illustrations. It is further not certain that the inventions in question can legitimately be classed as chemical.

Cosmos Les Mondes.
No. 13, March 31, 1883.

Combination-Heats of the Soluble Compounds of Magnesium.—Dr. D. Tommasi.—The author gives a table of the combination-heats of certain of these compounds as calculated and as found experimentally. Another table shows the calculated heats of another series of compounds, which have not yet been experimentally verified.

The Mixed System of Domestic Lighting according to M. Trouvé.—H. Valette.—This memoir requires the six accompanying illustrations.

No. 14, April 7, 1883.

Detection of Benzoic and Boric Acids in Milk.—Dr. Meissl.—For benzoic acid, 250 to 500 c.c. of milk are rendered alkaline by means of a few drops of lime or baryta water. The liquid is then evaporated down to a quarter of its bulk, made into a paste with a little plaster, and dried in the water-bath. Sand or pumice may be employed instead of the plaster. The dry matter is finely powdered, moistened with acidulated water, and agitated with twice its volume of cold alcohol at 50 per cent. The alcoholic extract contains the benzoic acid and the salts present in the milk. The liquid is neutralised with baryta water and concentrated to a very small volume. This residue is again acidulated with sulphuric acid, and finally agitated with small quantities of ether. The ethereal extract submitted to evaporation leaves benzoic acid in a state of almost absolute purity. Boric acid is not capable of quantitative determination except present in such proportions that its weight may be deduced from the increase in the quantity of ash. The blowpipe reaction is useless, since the ash of pure milk gives a flame bordered with green. The following method is preferable:—100 c.c. are rendered alkaline with lime water, evaporated to dryness, and incinerated. The ash is dissolved in a minimum of strong hydrochloric acid, filtered over carbon, and reduced to dryness. The residue is moistened with a little weak hydrochloric acid, a little tincture of turmeric is added, and it is finally dried in the water-bath. The presence of the smallest trace of boric acid gives this residue a vermilion or cherry-red colour. Strong hydrochloric acid gives also a cherry-red with turmeric, but this colour disappears on the addition of water, and turns brown on drying.

Electro-chemical Affinities.—Dr. D. Tommasi.—The author comments on the table found on p. 177 of Professor J. D. Everett's treatise on "Physical Unities and Constants." The author there states:—"The following table contains examples of electrolytic decomposi-

tion, requiring for their production the same quantity of electricity." Upon this, Dr. Tommasi remarks: "It is quite inaccurate to say that these substances absorb in decomposition the same quantity of electricity, as they would then require for their decomposition the same quantity of heat, which, as is shown by an appended table, is not the case."

Calcination of Manganese Sulphite.—E. Maumené.—The author verifies the observations of M. Gorgeu.

No. 16, April 21, 1883.

It is announced that silk is now being used in Germany in the manufacture of cannon. A steel tube is covered round with silk thread until a sufficient tenacity is gained, and is then covered over with a stratum of gutta-percha or hardened caoutchouc to exclude moisture.

Thermo-chemistry and Electrolysis: Observations to M. Marcellin Langlois.—Dr. D. Tommasi.—The author points out the error of M. Langlois in believing that there exists no agreement between thermo-chemical data and the phenomena of electrolysis. In order that electrolysis may take place the calories produced by the battery must be at least equal to the calories absorbed by the electrolytes.

Justus Liebig's Annalen der Chemie,
Band 216, Part 3.

Boiling-Points of the Æthane and Ethylene Haloid Compounds.—A. Sabanejeff.—The differences of the boiling-points of the corresponding haloid derivatives of æthane and ethylene are constant, and vary only with the nature of the haloid, independent of its quantity. Those of the boiling-points of the chlorine compounds differ by about 30°, those of the bromine derivatives by 23°, and those of the iodide compounds by 16°.

Derivatives of Acetylene.—A. Sabanejeff.—The author treats of the preparation and properties of acetylen-dibromide, the mixed haloid compounds of acetylene, acetylene-chloro-iodide, acetylene-bromo-iodide; the action of certain reagents upon acetylene-dibromide, especially of water, of potassium carbonate and acetate, of silver acetate and nitrate, of potassium cyanide, and of phenol-potassium.

Tribrom-ethylene.—A. Sabanejeff and P. Dworkowitsch.—In tribrom-ethylene only one atom of bromine can be easily replaced by the phenol residue. On further energetic reaction of the phenol-potassium, there occurs, not substitution, but oxidation, with formation of oxy-phenyl-acetic acid. It is probable that intermediate products may be obtained under favourable circumstances.

Communications from the Chemical Institute of Marburg.—These consist of contributions to the knowledge of the styrol derivatives by T. Zincke, and a memoir on styrol-disulphocyanide by A. Nagel.

Tropine.—G. Merling.—The author studies the action of methyl-iodide upon tropine, methyl-tropin-platin-chloride, the corresponding gold compound; methyl-tropin, methyl-tropin-methyl-iodide, methyl-tropin-methyl-platin-iodide, the oxidation of tropine with potassium permanganate, and its conversion into tropigenine; tropigenine platinum chloride, the analogous gold compound; nitroso-tropigenine; the behaviour of tropigenine with methyl-iodide and the regeneration of tropine; the oxidation of tropine with chromic acid; tropic acid, its silver salt, and its decompositions.

Vol. 217, Part 1.

Amidoid Derivatives of Hydroxylamine: Four Metameric Benzoyl-anisyl-ethyl-hydroxylamines.—Dr. R. Pieper.—There exist four benzoyl-anisyl-ethyl-hydroxylamines sharply distinguished from each other by their chemical reactions.

Substitution-Products of the Phenol-ethers.—W. Staedel.—The author gives a summary of earlier researches in this direction, and discusses at great length the substitution-products of the phenol-ethers, certain new phenol-ethers, the nitro-cresols, the nitration of phenol-ethers, amido-cresyl-ether, and the brom-nitro- and brom-amido-anisoles and phenetoles.

Constitution of Atropine.—A. Ladenburg.—The author of this long dissertation considers his problem to be not yet solved. He shows the absolute identity of natural and artificial atropine.

Normal Paraffins.—C. Schorlemmer and T. E. Thorpe.—The authors examine the chemical behaviour of the heptan of *Pinus Sabiniana*.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xii., Part 3.

Loss and Gain of Nitrogen in Arable Soils under Different Methods of Cultivation.—P. P. Dehérain.—Already noticed.

Determination of Humus in Arable Soils.—Dr. G. Loges.—The author has submitted the chromic acid process for the determination of humus in arable soils to a careful examination. He finds that the total carbon present is in no case oxidised by chromic acid, the margin fluctuating between 96 and 64 per cent. Even in soils physically and chemically identical the deficiency is not constant. The method is therefore not applicable for accurate determinations.

Influence of Organic Manures upon the Temperature of the Soil.—Dr. F. Wagner.—The author finds that the temperature of a soil is raised by the incorporation of organic manures. This rise increases, other conditions being equal, with the quantity of the manure, with the temperature of the soil (within certain limits), and with the proportion of moisture. If the temperature of the soil is below 10° the heating action of the manure is almost completely arrested. The duration of the action is from four to twelve weeks, and the average gain of temperature is from 0.10 to 0.40°. This rise of temperature is too small to have any sensible effect upon vegetation.

Determination of the Value of the Different Forms of Phosphoric Acid as determined at Poppelsdorf, 1880 and 1881.—The author is unable to draw any conclusions from his experiments.

The Application of Sparingly Soluble Phosphates on Mineral Soils.—Dr. M. Fleischer and Dr. R. Kissling.—The power of dissolving phosphates possessed by peat-mould is affected in some cases favourably and in others unfavourably by the presence of salts which may be present in manures. The most unfavourable are the alkaline hydrates and carbonates, gypsum, and calcium chloride. Soda-salt-petre and kainite have a slightly favourable action. Potassium chloride and sulphate and ammonium sulphate have the most decided influence in promoting solubility.

Preservation of Green Fodder in Silos.—Prof. G. Lechartier.—The author notices a small loss in combined nitrogen, which shows itself as ammonia. The greatest loss is in the carbo-hydrates, especially glucose and sugar. Notwithstanding this loss, which may amount to one-fifth of the total dry solids, the author considers ensilage advantageous, as the fermented mass is more digestible. (To this assertion the abstractors of the *Central-Blatt* append a query.)

Determination of the Albumenoid and Non-Albumenoid Nitrogen in Vegetables.—Dr. C. Bøehmer.—The author finds that a considerable proportion of the nitrogen in the vegetables examined—from one-fifth to nearly one-half—exists as ammonia, amidic acids, and other non-assimilable forms.

MISCELLANEOUS.

Study of the Ultra-Red Radiations by Means of the Phenomena of Phosphorescence.—In a memoir presented to the Academy (January 8, 1883), M. H. Becquerel gave a measurement of the wave-lengths of the numerous rays and bands which the phenomena of phosphorescence enable us to discern in the ultra-red solar spectrum. The same method is very simply applicable to the study of the absorption-spectra of different substances, and in particular of the telluric bands in this region of the spectrum. The absorption of the sun's light by the earth's atmosphere gives in the ultra-solar region four broad bands, the mean wave-lengths of which, expressed in millionths of a millimetre, are 930, 1082, 1230, and 1470. When the spectrum is projected upon a phosphorescent substance we may follow with much distinctness the variations of intensity and breadth presented by these bands when the sun is more or less elevated above the horizon, and the air is more or less charged with vapours. The absorption-spectrum of water is discontinuous, and presents bands which appear to coincide with the broad bands of the solar spectrum just mentioned. M. Becquerel has further studied the absorption-spectra of certain earthy metals. Through the kindness of M. Lecoq de Boisbaudran he has been able to study the ultra-red absorption-spectra of a series of products containing, in different degrees of concentration, erbium, holmium, didymium, and samarium. These substances give absorption-spectra with very remarkable bands. M. Dessains has previously observed that didymium gives cold bands in the calorific spectrum. According to the determinations made with phosphorescent substances the absorption-spectrum of didymium in the ultra-red region is characterised by three very strong bands, the wave-lengths of which are 730.5 to 756; 782 to 819; and 872 to 890. When the solution contains little didymium the bands are narrower, and their mean wave-length is 743, 796, and 872. The solutions studied show various other bands, not counting those of water; two very strong bands, with wave-lengths of about 1010 and 1180, appear to belong to samarium; two others, weaker, 840 and 910, have not been definitely traced to any substance from the want of types for comparison. Solutions free from didymium, but containing erbium and holmium, display the band 811, ascribed by M. Soret to holmium, and a fainter band, of the wave-length 890. M. Becquerel has likewise studied the absorption-spectra of various other substances. Certain solutions of copper salts arrest all the ultra-red spectrum: a solution of nickel chloride arrests the ultra red spectrum, but lets pass that portion of the ultra-red spectrum which is not absorbed by water. A fragment of green glass lets pass merely that part of the ultra red spectrum comprised between 1150 and the least refrangible extremity. M. Becquerel has likewise studied the emission-spectra of metallic vapours.—*Comptes Rendus*, tome xcvi., No. 17.

MEETINGS FOR THE WEEK.

- TUESDAY, 15th.—Institution of Civil Engineers, 8.
— Pathological, 8.30.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
WEDNESDAY, 16th.—Society of Arts, 8.
— Meteorological, 7.
— Pharmaceutical, 11. (Anniversary.)
THURSDAY, 17th.—Royal Institution, 3. "Count Rumford," by Prof Tyndall.
— Chemical, 8. "Photographic Action Studied Spectroscopically," by Capt. Abney, F.R.S.
FRIDAY, 18th.—Royal Institution, 3. "Domestic Industry in the Villages of Russia," by Prof. Turner, 9.
SATURDAY, 19th.—Royal Institution, 3. "Russian Social Life," by Prof. Turner.

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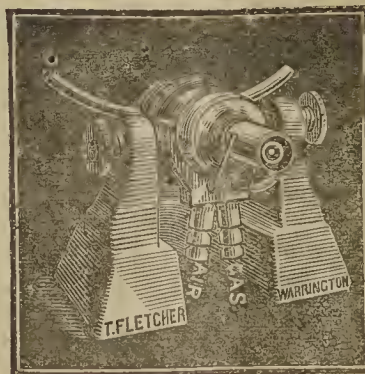
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1225.

BÜNTÉ'S APPARATUS FOR DETERMINATION OF FURNACE GASES.

By means of this apparatus a ready and sufficiently accurate separation and estimation of oxygen, hydrogen, carbonic acid, carbonic oxide, and nitrogen, may be effected in a comparatively short space of time, thereby supplying to practical men a long-felt want in the determination of furnace-gases, and enabling an operator with even a small amount of manipulative skill to ascertain the precise condition of the gaseous contents of the furnaces under his control.

Description of the Apparatus and Directions for Use.

A and B are two burettes fitted with three-way stopcocks, and each graduated in fifths of a cubic centimetre, and capable of holding about 110 c.c.; C, a one-gallon tabulated bottle, serving as a water reservoir; D, a suction bottle used for rarefying the gas subsequent to the introduction of reagents.

Burette A is first filled with water up to stopcock by connection with C, funnel *d* being also nearly filled. C is then disconnected from A and connection made between A and D; the gas to be examined is now allowed to flow in at *a*, the water flowing from A to D until nearly empty. Connection is now re-established with C, and water allowed to enter until the bottom graduation is reached; the stopcock *k* is now carefully turned in order to allow a portion of the gas (which of course is under pressure) to escape through the water in *d*, until there remains exactly 100 c.c. of gas at the normal atmospheric pressure. The apparatus is now under the proper conditions for analysis of the mixed gases.

Determination of Carbonic Acid.—Tube *r* of suction bottle is connected with the bottom of the burette, suction applied at *n* and stopcock *g* turned, and all the water allowed to run out; *g* is then closed and *r* removed; a solution of caustic potash is now applied, and *g* being opened, a quantity of the fluid enters; the burette is now taken from its support, the hand of the operator being placed firmly on *d*, and the gas is well shaken up with the liquid, this operation being again performed if absorption is found not to be complete. When this is effected, the stopcock at *k* is opened and water allowed to flow down until the normal atmospheric pressure is reached, indicated of course by the water ceasing to flow. The amount absorbed by the caustic potash is now read off = percentage of CO₂.

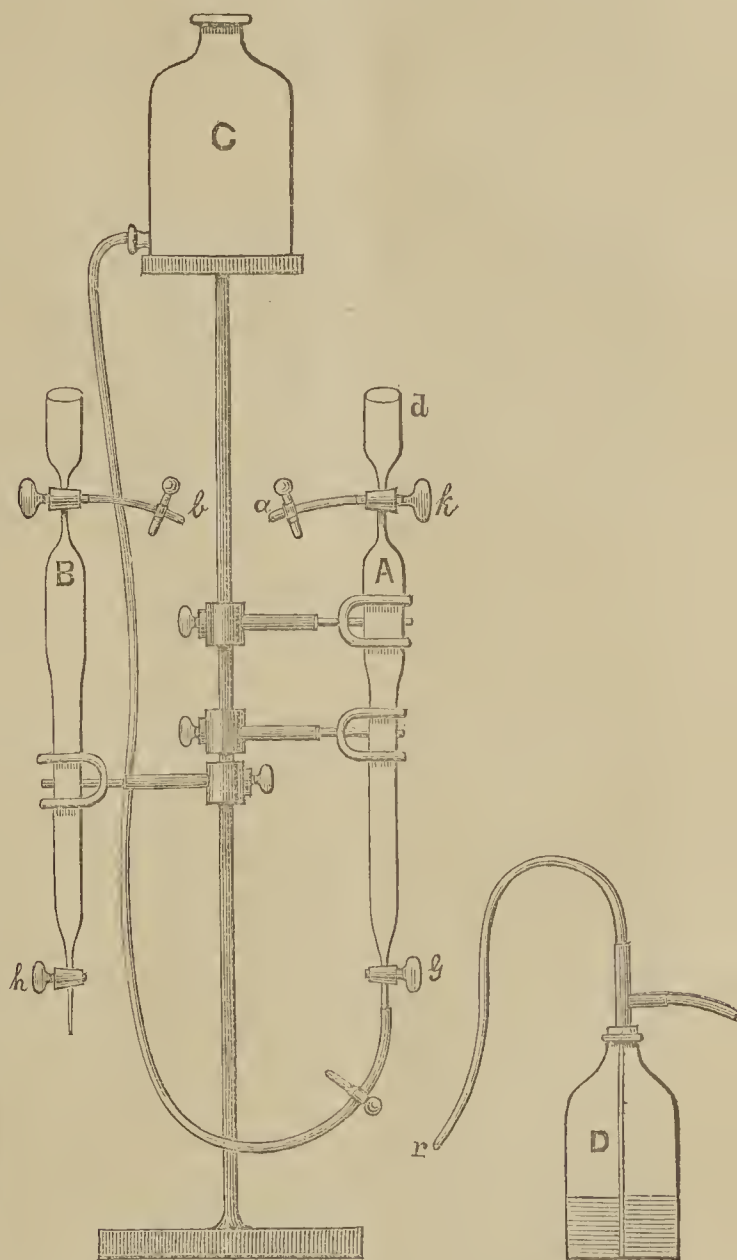
Determination of Oxygen.—The caustic potash solution is drawn off by means of the suction tube, and an alkaline solution of pyrogallic acid is applied in a similar manner as in estimation of CO₂; if oxygen be present the solution becomes immediately black and the diminution in volume after shaking as before, and reducing to normal pressure, gives the percentage of oxygen.

Determination of Carbonic Oxide.—If oxygen has been proved to be present, carbonic oxide will most likely be absent, unless the gases have been brought together at a temperature insufficient to promote their combination.

In order to effect the estimation of carbonic oxide by absorption it is necessary to remove every trace of the alkaline pyrogallate solution by the use of the funnel *d* and the suction bottle; this done, a concentrated solution of cuprous chloride in hydrochloric acid is applied to the bottom of the burette as before; when absorption is complete, the cuprous chloride is drawn off, the tube washed,

and treated with a solution of caustic potash, for the purpose of absorbing any hydrochloric acid vapour which may have been liberated in the reaction; after bringing to correct pressure, the reading shows percentage of carbonic oxide.

Carbonic oxide and hydrogen are, however, generally estimated by combustion, as follows:—The gas is allowed to mix with atmospheric air by turning the cock *k*, and momentarily releasing the pinch-tap, the water being permitted to flow out at *g*; normal pressure is then re-established by means of the funnel *d*, and a reading taken. Connection is now made between *a* and *b*, uniting the two by means of a piece of hard glass combustion tubing containing a small coil of palladium wire. Burette B is now filled with water by connection with C. The palla-



dium wire in the tube is brought to a red heat by means of a Bunsen burner, and the gas is caused to pass from A over the heated tube into B by opening *h* and *g*, connecting the reservoir water supply C with bottom of burette A. When all the gas has passed over the operation is reversed, the gas being again collected in A. It is allowed to stand until the normal temperature is attained, adjusted for pressure, and read off. It might perhaps be considered advisable to notice here what has taken place in the combustion. The gases remaining in the mixture are hydrogen, carbonic oxide, and nitrogen; by the admixture of air, and passage over the red-hot palladium coil, the oxygen of the air combines with the carbonic oxide

(CO) to form carbonic anhydride (CO_2), and with the hydrogen to form water, the nitrogen of course remaining unacted upon. If the gas under examination consist entirely of hydrogen and nitrogen, it is obvious that the diminution in bulk multiplied by two-thirds gives at once the percentage of the former gas; *e.g.*, supposing there to be present 10 c.c. of hydrogen, and 8 c.c. of nitrogen, and 22 c.c. of air have been admitted, the whole therefore measuring 40 c.c.; after combustion the measurement of the gas is found to be 25 c.c., showing loss in bulk of 15 c.c., which diminution is due to the combination of 10 volumes of hydrogen with oxygen 5 volumes, to form water 15 volumes (which latter occupies no appreciable space and may therefore be neglected), consequently $15 \times \frac{2}{3} = 10$ c.c. = vol. of hydrogen.

If carbonic oxide, hydrogen, and nitrogen be present, the calculation is still almost as simple. Supposing, for example, that the following mixture be contained in the burette:—

Carbonic oxide	10 c.c.
Nitrogen	12 "
Hydrogen	8 "

50 c.c. of air are admitted, the whole measuring 80 c.c.; after combustion it is found that measurement is reduced to $80 - 63 = 17$ c.c.; the 63 c.c. of gases being now submitted to the action of caustic potash solution in the usual manner, the carbonic anhydride produced in the reaction is thereby absorbed, and a further diminution of 10 c.c. observed, which indicates the percentage of carbonic oxide present, since for every volume of carbonic oxide burnt an equal volume of carbonic anhydride is formed; and since also that this 10 c.c. of CO must have consumed half its volume or 5 c.c. of oxygen, we obtain—

$$(17 - 5) \times \frac{3}{2} = 8 \text{ c.c. of hydrogen.}$$

Nitrogen being then calculated by difference.

ON THE DECAY OF BUILDING STONES.*

By WILLIAM WALLACE, Ph.D., F.R.S.E., F.I.C., F.C.S.

THE comparative durability of the varieties of stone suitable for building purposes is a theme of great interest to the architect; and this must plead my excuse, as a chemist, for intruding myself upon the members of a Society wholly engaged with matters connected with architecture and building construction. The most casual observation shows the most striking differences in the rocks which are brought to view by the operations of nature—some remaining firm and hard after countless ages of exposure to wind and rain, while others under similar influences have crumbled into dust. And again, an examination of the works of the architects and workmen of the old world exhibit differences not less striking. Many of the monuments of ancient Egypt and Greece show, even now, only the slightest traces of decay; while in our own country most of our cathedrals, and old churches, castles, and baronial halls have suffered great deterioration, and many of them are only saved from complete destruction by a careful system of renovation. No doubt it is scarcely fair to compare the durability of buildings in countries where rain seldom falls with those exposed to our own humid climate; but apart from this we have instances in our immediate neighbourhood which show the variations in regard to durability in different building materials exposed to the same climatic influences. While the old ecclesiastical buildings and baronial mansions, only a few centuries old, and constructed for most part of red sandstone, are mostly in ruins, with the stone ridged and furrowed, and the mouldings and carving all but obliterated, we find

in the Roman Wall, stretching from the Forth to the Clyde, as seen near Kirkintilloch, blocks of whinstone from the neighbouring quarry of Auchinsterry, in which we can almost see the marks of the workmen's tools, and which are really, so far as we can see, as fit for use now as the stones just taken from the quarry. Again, in some old feudal castles, built partly of mica schist, we find pieces of that excellent, but most intractable, building material with angles as sharp as if they had just been removed from the rock.

The principal building stones employed in this country for city architecture, if we except granite, the use of which is confined to one particular town and district, and which does not lend itself kindly to the artistic aspirations of the architect, are—1. Sandstone, or as it is generally called by builders, on account of the ease with which it is wrought, freestone; 2. Limestone in its more compact form; 3. Oolitic limestone; and 4. Magnesian limestone or dolomite. In the present short paper I propose to deal only with the first of these—sandstone—as it is the only one with which we are locally interested, all our buildings being constructed of that material, which occurs in great abundance in the new red sandstone, the carboniferous, and the old red sandstone strata. It is a common matter of observation that, apparently, little care is taken in the selection of the stone, even in cases where durability is most important; and it is a fair inference that architects really do not know how to distinguish a stone that will stand well from one that will rapidly decay. Certain quarries acquire a reputation because experience has shown that the stone taken from them has stood well; but the architect or builder who selects it cannot tell in what respect it differs from another stone that is known to be bad. It is in the hope of being able to throw a little light on the subject that I have ventured to introduce it, trusting that my remarks will lead to a discussion that will bring out many points of interest.

I have to acknowledge my indebtedness to Messrs. Watt and Wilson, contractors, for kindly supplying me with twelve specimens of stone from well known quarries. Of these I have made careful chemical analyses, and the results are contained in the subjoined table (see next page), and to which I shall frequently have occasion to refer. In regard to one of them, the first on the list, from Kenmure, Bishopbriggs, Messrs. Watt and Wilson say in the letter accompanying the specimens—"This seems to be a picked bit: it is well known that there is not much good weather stone to be got in the Bishopbriggs quarries now." In a letter of more recent date, in answer to an inquiry, they say it is from a new quarry, and that the quantity obtainable is probably not large.

Let us see, in the first place, what sandstone is. Its chemical composition, as well as its physical character, shows it to consist essentially of particles of sand—in other words, crystallised or crystalline silica—formed no doubt, by the disintegration of older rocks, and washed by the action of water into beds, sometimes of great thickness, where, by the infiltration of other substances, such as lime in solution, it has gradually been consolidated until it became a firm rock. Among the mineral substances found in sandstone, in addition to the leading ingredient silica—the most important, undoubtedly, as regards the formation of a hard and durable rock—are the carbonates of lime and magnesia. So great is the effect of these bodies in filling up the intervening spaces between the particles of sand and forming a firm mass, that the durability of a stone may, with tolerable accuracy, be deduced from the proportion of these compounds found in it. In the twelve specimens I have examined in connection with this paper, the amount of these carbonates varies from 0.57 to 12.58 per cent. I have to direct your attention, however, to the Craigleith stone, which is well known to be one of the most durable of its class, but which contains the smallest quantity of carbonates—0.57 per cent. Now, this stone is one of the heaviest in the list, and it is the least porous of all; whereas

* Read before the Architectural Section of the Glasgow Philosophical Society.

ANALYSES OF TWELVE SAMPLES OF SANDSTONE OBTAINED FROM MESSRS. WATT AND WILSON, CONTRACTORS.

AIR-DRIED.

Name of Quarry	Kenmure.	Overwood.	Giffnock.	Dunmore.	Ravens- craig.	Craigleith.	Polmaise.	Polmaise.	Inverkip.	Bothwell Park.	Corsehill.	Wemyss Bay.
Colour of Stone	White.	White.	White.	White.	White.	White.	White.	Yellow.	Light pink.	Red-brown.	Red.	Red.
Silicious Matter, insol. in acid	86.26	88.86	94.94	94.48	96.99	98.29	84.14	93.20	95.76	95.28	94.32	96.67
Alumina	0.80	1.19	0.56	0.68	0.78	0.49	0.52	0.32	1.77	0.51	1.34	0.81
Peroxide of Iron	2.62	2.50	1.22	0.80	0.14	0.27	1.92	1.20	0.47	0.98	1.70	1.05
Carbonate of Lime	5.72	2.30	1.28	2.47	0.31	0.36	7.92	2.94	0.30	0.51	1.44	0.37
Carbonate of Magnesia	3.33	1.97	0.89	1.13	0.21	0.21	4.66	1.57	1.16	0.33	0.59	0.74
Phosphate of Lime	0.15	0.11	0.07	0.04	trace	0.04	0.08	0.03	0.05	0.04	0.11	0.09
Sulphate of Lime	0.09	0.10	0.06	0.07	0.05	0.08	trace	0.03	0.08	0.07	0.05	0.08
Loss on Ignition	0.75	0.62	1.10	0.35	1.17	0.28	0.04	0.55	0.24	—	0.33	0.26
Water at 212° F.	0.11	2.10	0.04	0.20	0.18	0.09	0.04	0.09	0.32	1.42	0.72	0.30
Specific Gravity	99.83	99.75	100.16	100.22	99.83	100.11	99.32	99.93	100.15	99.14	99.60	100.37
Weight of a Cubic Foot, lbs.	2.318	2.249	2.113	2.165	2.052	2.260	2.192	2.202	2.137	2.048	2.063	2.078
Cubic Feet per ton	144.4	140.1	131.7	134.9	127.9	140.8	136.6	137.2	133.2	127.6	128.6	129.5
Absorption of Water, per cent	15.5	16	17	16.6	17.5	15.9	16.4	16.3	16.8	17.5	17.4	17.3
Colour after Ignition	Dark red- dish grey.	Reddish grey.	Grey.	Light grey.	White.	Nearly white.	Yellow grey.	Red.	Light red.	Rather dark red.	Deep red.	Deep red.
Total Carbonates	9.05	4.27	2.17	3.60	0.52	0.57	12.58	4.51	1.46	0.84	1.03	1.11

in the others the weight is directly, and the porosity inversely, proportionate to the quantity of the carbonates of the alkaline earths. The fact is that this Craigleith stone is not a true freestone or sandstone, but approaches in its nature to the "kingle" of mining engineers—a kind of quartz rock or metamorphosed sandstone of great hardness. How it is formed is probably not certainly known, but my impression is that it has become indurated by an infiltration of silica dissolved in water which has percolated through it. I understand that this stone, which is very hard, is chiefly used for the steps and landings of stairs, and very little, if at all, for general building purposes.

The alumina, the proportion of which varies from 0.32 in the yellow Polmaise stone to 1.77 in the pink coloured Inverkip stone, is probably due to the undecomposed minerals associated with the sand, and is not likely to have much influence on the strength or durability of the stone. When, however, it exists in the form of clay, as is sometimes the case (and probably clay exists to a small extent in all sandstones), it is adverse to the durability of the stone.

The oxide of iron is interesting as forming the colouring matter of the red varieties of sandstone; but it exists in all to a greater or less extent. It appears somewhat anomalous, but it is the fact, that some of the whitest specimens contain more oxide of iron than those of a bright red colour. Thus the Kenmure and Overwood stones gave, on analysis, respectively, 2.62 and 2.5 per cent. of oxide of iron; while the Bothwell Park and Wemyss Bay samples gave only 0.98 and 1.05 per cent., or less than half the quantity. The colour of a stone, therefore, does not give the slightest clue to the amount of oxide of iron it contains. The smallest proportion in any of the specimens is in the Ravenscraig stone, which remains perfectly white when calcined, while all the rest become more or less coloured when ignited. My idea is that in the red stones, such as Corsehill and Wemyss Bay, the oxide of iron exists in the free or uncombined state—that is, mechanically mixed with the other constituents; while in the white varieties it is in combination, probably as a silicate of the protoxide. In yellow stone, such as the Polmaise, it probably exists in the free state, but in a hydrated condition, as these stones become bright red when subjected to a strong heat. It is well known to builders that some kinds of sandstones are liable to become disfigured with blotches, or spots of oxide of iron. This arises from patches, or nodules of pyrites, in the stones, which are readily altered by exposure to air and water, forming sulphate of iron, which gives yellow hydrated peroxide on coming to the surface; the sulphuric acid being taken up, wholly or in part, by the lime and magnesia present in the stone.

The remaining mineral constituents of sandstones—phosphate and sulphate of lime—exist in quantities too minute to exercise an appreciable influence in their hardness, strength, or durability. They are interesting rather from a scientific than a practical point of view.

The quantity of water retained after long exposure to the air in a moderately dry atmosphere is very small, and varies from a mere trace up to about 2 per cent. There is no reason to doubt that it is influenced by the temperature and degree of humidity of the air.

We have now two physical properties of sandstones to consider; their weight or specific gravity, and their porosity, as indicated by the quantity of water they absorb when immersed in that liquid.

The table shows the specific gravity, and, calculated from that the weight of a cubic foot in pounds, and the number of cubic feet in a ton. In all cases the stone was air-dried. The lightest stones were the Ravenscraig, Bothwell Park, Corsehill, and Wemyss Bay, and the heaviest were the Kenmure, Overwood, Craigleith, and Polmaise—the heaviest of all being the Kenmure, with its 9 per cent. of carbonates of lime and magnesia. The latter weighs 144 lbs. per cubic foot, while the Bothwell

Park weighs only 127½ lbs., a difference which is very striking.

The quantity of water the stones are capable of absorbing appears to be closely connected with the specific gravity. The best stone in this respect is the Craighleith, which takes up only 3·4 per cent; the Kenmure comes next, with 3·9 per cent; the Polmaise faintly pink or white stone, which is very high in lime and magnesian carbonates, is nearly as good, with 4·4 per cent. The Overwood and Dunmore stones take 5 and 5·1 per cent, and the Giffnock and Ravenscraig 5·9 and 6·1 per cent respectively. The Polmaise yellow stone takes 5, and the Inverkip slightly pink stone 5·5 per cent. The greatest quantity is absorbed by the red stones, which take up respectively 6·1, 6·4, and 7·2 per cent—the last proportion being that taken by the Wemyss Bay stone.

I am not inclined to dogmatise in the matter of the interpretation of these results, but I think you will have no difficulty in agreeing with me that, as a general rule, a sandstone is the better the heavier it is, the less water it absorbs, and the more its pores are filled up with cementing material, such as the carbonates of lime and magnesia. Taking all these considerations together, I would prefer for building purposes, of the twelve stones contained in the table, the Polmaise light-coloured stone and that from Kenmure, both of which I would regard as of first-class quality. Again, among the other white stones, I would not hesitate to prefer the Overwood and Dunmore stones to that from Ravenscraig. The three dark red stones I would consider inferior in quality for outside work, especially in the atmosphere of a city, which is something distinctly different from the air of the open country.

The usual form of decay of sandstones is simply the disintegration of the surface, the binding material being removed by climatic influences, and nothing left but the sand, which may be rubbed off freely with the hand. There is, however, another form of disintegration which I had a few years ago occasion to investigate—that in which the surface comes away in distinct scales. The building was a ducal mansion of large dimensions, and a sandstone was used which contained an unusually large proportion of alumina, with a very fair quantity of carbonate of lime. After a year or two the surface began to scale off, particularly at angles, curves, and other exposed parts, especially close to the ground; and the scales were about one-eighth of an inch thick and very uniform. I found that the original stone contained 5·2 per cent of carbonate of lime, while in the scales it was reduced to 2·04 per cent. I had no doubt at the time, nor have I any doubt now, that the reduction of this ingredient was closely connected with the disintegration, if not its actual cause.

Sandstone is very porous, and absorbs water with avidity. A moderate shower of rain falling on the surface of a building constructed of freestone is entirely absorbed, at least at first, until the surface becomes saturated with water. The carbonates of lime and magnesia are only very slightly soluble in pure water, but much more so in water containing carbonic acid, as all waters do to a greater or less extent, although the proportion in rain-water is very small. Every shower that falls, therefore, removes a certain very minute quantity of these binding materials, and in a correspondingly minute degree weakens the stone. But this same operation, constantly repeated year after year, begins by-and-bye to tell upon the stability of the surface, and particularly if the stone have only a minute quantity of the earthy carbonates to start with. In towns we have also sulphuric acid in the air in appreciable quantity, and the rain that falls first is generally acid to litmus paper. This is derived from the sulphur in coal, and from various manufacturing operations, and, of course, is more abundant in large and closely-built towns than in those which are small and widely spread out. It follows that a stone which stands well enough in the country, or in a small town or village, may be very unsuitable for a large city; and the same thing applies to roofing slates,

some of which are much more affected by acids than others.

If the walls of houses were entirely vertical, without any horizontal surface to catch the rain, the deterioration of stone would go on with extreme tardiness; but, as a matter of fact, there is a great deal of horizontal work about our houses and other buildings, consisting of window sills and lintels, porches, capitals, string courses, plinths, and so on—all these forming receptacles for catching the rain, a large proportion of which percolates through the stone and appears at a lower level. If you examine a few of the more recently erected buildings in Glasgow, where disintegration of the stone has set in, you will find that the process always shows itself first immediately below a flat projecting surface, and frequently there is no apparent injury to the stone elsewhere. The flow of rain-water over the surface of stone injures it only very slowly; the greater part of the damage is done by water passing through the stone, entering on a flat, or nearly flat, surface, and passing out at a lower level. In this way the stone in ordinary weather, alternately fair and rainy, never gets time to dry, but is always more or less damp.

The form of architecture adopted by the Greeks, and which in its pure or modified form is much used in city architecture, is well suited for a dry and warm climate, but much less so for a humid condition of atmosphere, such as that which obtains in this country. The Gothic style of architecture, whether accidentally or intentionally I cannot say, is better adapted to our climate, since the projecting courses of masonry are for the most part in the form of pointed arches, which permit the water to run rapidly off. Not that I would for one moment suggest that we should discard the Greek and Italian styles and adopt the Gothic; but I think something might be done to render these styles compatible with the exigencies of our over-humid climate. This brings me to what is, perhaps, the most important part of my communication—*i. e.*, the suggestion of means by which the decay of sandstone may be prevented or retarded.

Of course, the first consideration is to select for a building—and especially if it be one of a public and important character—a stone of the first quality. Next in order of importance is the covering of all flat, or nearly flat, surfaces with something that will prevent the rain which falls from passing through the stone. But I would advise architects, as far as possible, to avoid flat surfaces, and to give to window-sills and all projections as steep a slope as is consistent with the character of the building. A plan which I have advocated, and which is particularly adapted to projecting work at a considerable elevation, is to fill in the angle with Portland cement, so as to make a rather steep slope, which will completely prevent water from lodging or passing through the porous stone. This has also the merit of securely covering the joint between the projecting course of masonry and the flat stone immediately above it. When the use of cement is objectionable the slightly-sloped surface should be coated twice or three times with a tolerably strong solution of water-glass or silicate of soda, which will effectually fill up the pores and prevent water from passing through the stone. White-lead paint mixed with boiled oil may also be used, but it must not be applied to the stone until it is perfectly dry, and three or four coats are required. If all the projecting surfaces are thoroughly protected in any of these ways, the covering of the perpendicular surfaces is of comparatively little consequence, and will not be required unless the stone is of very bad quality. In extreme cases it is necessary to coat the whole surface with oil paint or silicate of soda,—both of which, however, are inapplicable to a grand public building, the painting of which would be justly considered as an act of Vandalism as great as the plastering up of the grand old Gothic columns in some of the English cathedrals, which was practised in an age more remarkable for sturdy piety than for cultivated taste and artistic skill. There is a material, however, which I may mention to you, which gives a complete and imper-

vious coating to polished ashlar without materially changing its colour or general appearance. It is prepared by the Broxburn Oil Company, and is called "Alexinton, or Damp Repeller." I am not at liberty to state the composition of the liquid, but may merely say that it is a solution of a solid body in a highly volatile liquid. When applied to a wall the volatile solvent speedily evaporates, and the deposited solid completely fills up the pores on the surface, and renders the stone impermeable by water. This liquid may be applied not only to flat, or nearly flat, surfaces, but to an entire building, and I consider it particularly valuable for coating elaborate work, such as the capitals of pillars.

Where an entire building is coated with an impervious substance—which, in the case of ashlar, may be any of the liquid applications I have mentioned, and in rubble-work or brick may be Portland cement or mastic—it is of the utmost importance that the walls should be allowed to dry first. A two-foot wall will take, at the very least, two years to dry, and the quantity of water that passes away from it is larger than might be supposed. A fair-sized country villa, say 50 feet square and 30 feet high, will contain about 8000 cubic feet of solid masonry, weighing about 500 tons, which will contain, as originally built, about 25 tons of water, or 5600 gallons,—and all this has to be evaporated before the house is comfortable or safe to live in. Probably it makes its escape about equally from the outside and the interior; but, at all events, the process is a slow one, and in the case of buildings not protected by a damp course from water sucked up by the porous stone from the foundations, it is never complete. It is, therefore, unwise to coat the walls of a house with an impervious coating until towards the close of the second summer after the completion of the house. This rule does not apply, however, to coating the flat and other projecting surfaces, which may be carried out at any time during dry weather.

A NEW METHOD FOR THE VOLUMETRIC DETERMINATION OF PHOSPHORIC ACID IN THE SUPERPHOSPHATES.

By A. MOLLEND.

AFTER a general description of the superphosphates, the author proceeds to say that, confining his attention to such superphosphates as contain no free acid, he has considered the possibility of determining the percentage of phosphoric acid of the acid calcium phosphate by titration with normal soda or sodium carbonate. It is known that 1 mol. of calcium phosphate requires 2 mols. sulphuric acid to form 1 mol. acid calcium phosphate. The titration of a solution of superphosphate with normal soda requires that the acid calcium phosphate should be so far neutralised with alkali as to form merely the ordinary sodium phosphate. As in a solution of superphosphate, calcium sulphate is present along with acid calcium phosphate; and as the former is readily decomposed during titration with sodium carbonate, which would be inconvenient for the determination of the soluble phosphoric acid, the lime must be removed from the solution of superphosphate before titration. This is best effected by means of sodium oxalate, for ammonium oxalate is readily decomposed on heating with sodium carbonate, giving off free ammonia, and rendering accurate titration impossible. Sodium oxalate converts acid calcium phosphate into acid sodium phosphate. The sodium oxalate may be added in excess. The sodium sulphate formed, being a neutral salt, does not act upon litmus, and is therefore not injurious in titration.

The determination of the phosphoric acid in a superphosphate by titration with normal sodium carbonate is thus conducted:—Ten grammes of the powdered and

sifted sample are dissolved in water, made up to 500 c.c., let stand for four hours, shaking frequently, filtered, and portions—each of 100 c.c.—are measured off for titration. Of this solution 100 c.c. represent exactly 2 grms. superphosphate. These 100 c.c. are heated to boiling in a beaker supersaturated whilst boiling with sodium oxalate, filtered after the precipitate of calcium oxalate has subsided, well washed, and the filtrate and washings are titrated after adding a few drops of pure neutral tincture of litmus. (As indicator azolitmine is recommended, a blue colouring matter extracted by Stolba's process from the ordinary tincture of litmus.) The liquid to be titrated is raised to a boil, and normal sodium carbonate is added from a burette until the liquid is distinctly blue. It is then still boiled for a few minutes, and let cool. If when cold the solution takes a reddish violet colour the titration is not complete. It is therefore heated again, and from 0.1 to 0.2 c.c. of the normal sodium carbonate is cautiously added, repeating this operation till the liquid remains blue when cold. The c.c. of normal sodium carbonate consumed are read off and noted.

If dissolved bones are titrated the beaker containing the solution must be set upon white paper, as the liquid itself is yellow, and with tincture of litmus appears reddish yellow. When the titration is complete it takes a greenish grey colour. With the ammoniacal superphosphates good results are not obtained, as ammonium sulphate is decomposed in heat by sodium carbonate. It is therefore preferable to titrate ammoniacal superphosphates in the cold with normal caustic alkali.

The author has also tried the titration of the soluble phosphoric acid with semi-normal soda. The lime was first removed from the solution with sodium oxalate, and the filtrate titrated. The process is trustworthy, and is simpler than that with sodium carbonate, as it is performed in the cold. On this account ammonium oxalate can be used instead of sodium oxalate for the removal of the lime, as there is no fear of its being decomposed by the alkali. From the same reason ammoniacal superphosphates may be titrated with caustic soda.

If a superphosphate contains free acid (sulphuric or phosphoric) the difficulty may be overcome by adding to the solution, drop by drop, lime-water or sodium carbonate until a faint turbidity appears, which does not disappear on stirring. This partial neutralisation is effected before the removal of the lime with ammonium or calcium oxalate. As a precipitate formed may contain phosphoric acid combined with iron or lime, the quantity of sodium carbonate solution required for neutralisation is best ascertained by a separate experiment. So much is then added to the liquid to be titrated that it just remains clear, and the lime is then removed at a boil with sodium oxalate.

When titrating in the cold with normal soda, phenolphthaleine or phenacetoline may be advantageously used as indicator. The process may be still further abridged by not filtering off the precipitate of calcium oxalate, but adding at once to the milky liquid when cold a few drops of phenolphthaleine, and titrating at once. The first drop of soda in excess gives a red colour.—*Zeitschrift für Analytische Chemie.*

The Petroliferous Beds of Central Europe.—L. Piedbœuf.—A very full account of the petroleum beds of North Germany, and of the attempts at their utilisation. The author states that a well opened last June, at Oelheim, in the Hanoverian district, has since then yielded regularly 35 barrels daily. A well at Sloboda Rungurska, in Galicia, yields daily 45,000 kilos. of petroleum, or more than 275 barrels. It is said that, as regards price and quality, the German and the American petroleum meet on an equal footing in the market at Bremen. The German petroleum yields especially certain heavy oils, which for lubricating purposes seem superior to similar products from America.—*Revue Univ. des Mines, &c.*, No. 1, 1883.

DETERMINATION OF ORGANIC MATTER IN
POTABLE WATER.*

SECOND PAPER.

By Prof. J. W. MALLET, F.R.S., University of Virginia.

(Concluded from p. 220).

ALBUMENOID-AMMONIA PROCESS.

THE examination of modified forms of this process was undertaken by Dr. Charles Smart, U.S.A., who has furnished the following statement of results obtained. The appointment of Dr. Smart to the office of Secretary to the National Board of Health, and the pressure of duties thus entailed upon him, have prevented the whole plan of experiments intended being carried out, but the main points on which information was sought have been covered.

"The experiments detailed below were intended to determine the conditions under which ammonia in small quantities is evolved from its containing liquid, and those under which perfect condensation or absorption may be subsequently obtained.

Series of Experiments on the Liberation and Condensation of minute quantities of NH₃.

The charge for distillation consisted of so many c.c. standard NH₃ solution (1 c.c.=0.01 m.grm. NH₃) + so many of ammonia free water, making a total of 500 c.c.

A. 1 m.grm. NH₃, ordinary distillation. Temperature of distillate 27° C.

0.50 0.21 0.055 0.01=0.855=14.5 per cent loss.

Compare with H and I.

B₁. 0.5 m.grm. NH₃, ordinary distillation. Temperature of distillation 28° C. Temperature in retort 101° C.
0.40 0.06 0.005=0.465=7 per cent loss.

B₂. 1 m.grm. NH₃. Conditions as in B₁.

0.76 0.10 0.01 0.00=0.87=13 per cent loss.

Compare with A in which gas-jet was smaller and time of distillation longer.

B₃. 2 m.grms. NH₃.

1.34 0.32 0.05 0.01 50.00=1.725=13.75 per cent loss.

C₁. 1 m.grm. NH₃, receiver closed by sulphuric acid bulbs, connected with water-jet, tension reduced 6 inches; retort heated in vessel of boiling water. Temperature in retort 95° C., of distillate 28° C. Distillation slow (90 minutes for 50 c.c.)

0.46 0.28 0.14 0.035 0.015 with 0.01 in acid=0.94=a loss of 6 per cent.

C₂. 2 m.grms. NH₃. Temperature in retort 96° C.; other conditions as in C₁.

0.77 0.56 0.27 0.12 0.06 0.025 with 0.035 in acid=1.84=a loss of 8 per cent.

D₁. 0.5 m.grm. NH₃. Conditions as in C, but flame applied to retort. Temperature in retort 97 to 97.5° C., of distillate 28° C. Distillation rapid (12 minutes for 50 c.c.)
0.36 0.075 0.01 with 0.02 in acid=0.465=a loss of 7 per cent.

D₂. 1 m.grm. NH₃.

0.72 0.20 0.035 0.015 with trace in acid=0.97=a loss of 3 per cent.

D₃. 2 m.grms. NH₃.

1.41 0.36 0.05 0.01 and trace only in acid=1.83=a loss of 8.5 per cent.

E₁. 0.5 m.grm. NH₃, ordinary distillation, but receiver closed by sulphuric acid bulbs. Temperatures 101° and 28° C.

0.37 0.075 0.015 with 0.02 in acid=0.48=a loss of 4 p. ct.

E₂. 1 m.grm. NH₃.

0.72 0.19 0.035 0.005 with 0.02 in acid=0.97=a loss of 3 per cent.

E₃. 2 m.grms. NH₃.

1.39 0.34 0.07 0.01 with 0.03 in acid=1.84=a loss of 8 p.ct. Compare E with B₁.

F₁. 1.5 m.grm. NH₃. Conditions as in E, but pure water in bulbs instead of sulphuric acid.

1.12 0.20 0.02 0.005=1.345=10.3 per cent loss.

G₁. 0.5 m.grm. NH₃. Conditions as in F, but with water-flask as guard beyond the water-bulbs.

0.37 0.07 0.015=0.455=a loss of 9 per cent.

G₂. 1 m.grm. NH₃.

0.72 0.18 0.03 0.0025 and trace in bulb=0.9325=6.75 per cent of loss.

G₃. 2 m.grms. NH₃.

1.41 0.32 0.065 0.01 with trace in water=1.805=a loss of 9.75 per cent.

Compare G with E and B.

H₁. 0.5 m.grm., ordinary distillation. Temperature of distillate 6° C.

0.40 0.08 0.02 0.00=0.50.

H₂. 1 m.grm. as in last.

0.80 0.14 0.03=0.97=loss of 3 per cent.

H₃. 1 m.grm. as in last.

0.80 0.15 0.03=0.98=loss of 2 per cent.

I₁. 0.5 m.grm. condensed in coil 18 feet long. Temperature of distillate 6° C.

0.08 0.32 0.08 0.015 0.005=0.50

I₂. 1 m.grm. as last.

0.43 0.38 0.12 0.04 0.01=0.98 m.grm.=loss of 2 per cent.

I₃. 1 m.grm. as last.

0.35 0.40 0.12 0.07 0.03=0.97 m.grm. NH₃=loss of 3 p. ct.

Second Series of Experiments on the Liberation and Condensation of minute quantities of NH₃ from Water.

I. 0.5 m.grm. NH₃, in a retort connected with a water-jet pump, no condenser, but sulphuric acid bulbs between retort and pump, 6½ inches pressure removed; stream of air passing through apparatus entering by means of a glass wool filter moistened with sulphuric acid. Temperature 28° C. After twenty-four hours 0.11 m.grm. NH₃ was found to have left the retort for the acid bulbs.

II. 0.5 m.grm. NH₃, apparatus as in I, but temperature in retort kept at 63° C. At the end of twenty-one hours, 190 c.c. of the water were found to have passed into the acid bulbs and flasks, carrying with them all of the NH₃.

III. 0.5 m.grm. NH₃, apparatus as last. Temperature in retort 55° C. At end of eighteen hours, 85 c.c. were found to have passed over, carrying with them 0.488 m.grm. NH₃.

IV. As last. At end of six hours, 31 c.c. had passed over with 0.29 m.grm. NH₃.

V. As last, but with the air drawn *through* the liquid to cause an artificial ebullition. At the end of five hours, 0.27 m.grm. was found in the acid.

VI. As last, but with 9 inches pressure removed. Temperature 50° C. At the end of sixteen hours, 60 c.c. had come over, bringing all the NH₃.

VII. As last. At end of four hours the 10 c.c. which had come over contained only 0.25 m.grm. NH₃.

VIII. As last, but with 10½ inches pressure removed. Temperature 49° C., and 6½ hours of exposure, 13 c.c. passed over containing 0.27 m.grm. NH₃.

Experiments on the Decomposition of Urea during Distillation of the Water holding it in Solution.

The urea used in these experiments contained 0.45 per cent of free NH₃. This amount must be deducted from the first recorded results of every experiment.

1st. 10 m.grms. urea (containing 0.045 m.grm. NH₃) in 500 c.c. water distilled from water-bath, and with 6½ ins.

* Report on the results of a supplementary investigation, made by the direction of the National Board of Health. From *American Chemical Journal*, vol. iv., No. 6.

pressure removed from interior of apparatus. Temperature in retort 96°C . Two hours required for the distillation of each measure of 50 c.c.

Result 1st measure 0.19 m.grm.
2nd " 0.37 "

2nd. 10 m.grms. urea, but without the water-bath and jet-pump. Distillation rapid: twelve minutes for 50 c.c.

1st measure 0.12 m.grm.
2nd " 0.10 "

3rd. 20 m.grms. (containing 0.09 m.grm. NH_3) operated on as in experiments I., II., III., &c. At the end of five hours 40 c.c. had passed over, carrying with them 0.19 m.grm. NH_3 into the acid.

4th. 20 m.grms. urea were permitted to remain under the influence of the jet-pump and passing air current as in I. for forty hours: 0.14 m.grm. was found in the acid.

5th. 20 m.grms. were exposed in solution to the air for forty hours, and at the end of that time showed the presence of 0.09 m.grm. NH_3 as when freshly dissolved.

6th. 20 m.grms. at 60°C . and $6\frac{1}{2}$ inches for seven hours gave 0.20 m.grm. NH_3 in 40 c.c. which passed over into the acid bulbs.

7th. 20 m.grms. at 60°C . and $6\frac{1}{2}$ inches for sixteen hours gave in 65 c.c. distilled 0.25 m.grm. = 0.16 m.grm. when the 0.09 free NH_3 is deducted.

8th. 35 m.grms. urea (containing 0.16 m.grm. NH_3) at 55°C . and pressure as in last gave after sixteen hours 67 c.c. containing 0.29 m.grm. NH_3 .

9th. 35 m.grms. urea as in last, but with only six hours exposure, gave 0.035 in 26 c.c. distilled. This 0.035 represents the decomposition effected during the time, as the residue from 8 was used, and it was free from the original ammonia taint of the urea.

10th. The residue from 9, treated as before for sixteen hours, gave 0.09 in the 70 c.c. which passed over.

A comparison of C and D shows that water containing a trace of ammonia may be heated within a degree or two of its boiling-point without any rapid evolution of the ammonia, but that as soon as the extra degree or two needful to cause ebullition has been added, the ammonia passes over rapidly with the watery vapour. Ninety minutes of a heat just below the boiling-point are required to accomplish what may be effected in twelve minutes if that point is attained. A reduction of pressure on the surface of the liquid promotes the evolution, by causing ebullition at a lower temperature; compare D with E. A diminished pressure no doubt acts at all temperatures in aiding the evolution; and a weak solution, as in I., may lose its ammonia at ordinary temperatures, but the length of time required to effect this renders the process valueless as a practical method. Nevertheless, by increasing the temperature under the lessened pressure, the time required may be so reduced as to give the process a value in practice.

As the rapidity of the evolution of the ammonia from the water containing it depends mainly on the presence of heat sufficient to boil the water, so a perfect condensation, where heat has been applied to cause rapid evolution, can only be obtained by the needful reduction of temperature: compare the whole series A, B, and C with H and I. Where the condensing liquid runs freely from the tap through the condenser so as to give the distillate a temperature a few degrees above the freezing-point, the ordinary condenser is as efficient as one with a condensing tube many times longer: compare H and I.

But where the liberation of the ammonia is effected slowly under reduced pressure and at temperatures considerably below the boiling-point, the whole may be recovered by absorption in acid without the aid of a condensing circulation. See experiments II., III., and VI.

As with the evolution of ammonia so with the decomposition of urea: it is effected slowly at temperatures below the boiling-point, but as soon as that point is reached the ammonia from its dissolution is given up

rapidly. Compare experiment 2 with the others of that series.

Practically it may be said that where we are dealing with free ammonia and non-volatile and stable organic matter in a water, the ordinary process with a condensing medium which gives a proper temperature to the distillate may be considered satisfactory.

But where we have to discriminate between free ammonia and urea, the slower method by absorption in acid under reduced pressure may be of value. The experiments 3 to 8 show that if the operation is commenced in the afternoon and permitted to continue until next morning, the whole of the ammonia may be expected in the acid bulbs, and this may be assumed with greater certainty if more than one-tenth of the liquid has distilled in the meantime; but if the operation is commenced in the morning or forenoon, it is doubtful if it can be completed in the ordinary working hours of the laboratory. Experiments 7 to 10 indicate that during this liberation of the free ammonia present, the urea which may accompany it will only suffer decomposition to the extent of from three- to eight-tenths of one per cent.

CH. SMART, U.S. Army."

PERMANGANATE PROCESS.

Maintenance of an approximately constant excess of Permanganate during the progress of action on the Organic Matter in a sample of Water.

The effect of thus modifying the permanganate process as described and used by Tidy was tested as follows:—The process was first applied in its usual form to water artificially polluted with organic matter,* extending, however, the time of action to twenty-four hours, and making determinations in separate flasks of the oxygen consumed at the end of one, three, six, nine, twelve, and twenty-four hours respectively. Enough of the organic matter was used to consume altogether a large proportion of the oxygen of the charge of permanganate. Having plotted off a curve on paper representing the rate of consumption of the oxygen as thus found, it was determined how much additional permanganate should be added at the end of each half-hour for the first three hours, at the end of each hour for the succeeding nine hours, and at the end of each six hours for the remaining twelve hours, in order to maintain, as nearly as these intervals would permit, a constant excess throughout the whole period. These additions were made at the proper times to a new lot of the polluted water altered only by keeping for one day, and determinations were made as before of the oxygen consumed at the end of one, three, six, nine, twelve, and twenty-four hours.

Results a little higher were obtained by this modified process as compared with those given by the former method. The difference, however, was not very great. The chief evidence of greater regularity of action was furnished by experiments, made simultaneously, on two different dilutions of the same solution of organic matter.

These gave results as to oxygen consumed which were almost exactly in proportion to the difference of strength when the modified process was used, whereas the stronger solutions gave somewhat lower results than would have been calculated from those for the weaker dilutions when the original form of the process was applied. These comparative experiments were too few in number to generalise from with much positiveness, but they may fairly be taken, as far as they have gone, in confirmation of the soundness of the principle on which the suggested improvement is based.

Specific Heats of Certain Gases at High Temperatures.—M. Vieille.—The author has verified the identity of the specific heats of hydrogen, nitrogen, oxygen, and carbon monoxide gases at temperatures up to 2700° .—*Comptes Rendus*.

* An infusion of dead forest leaves and the drainings from a pile of animal manure were the polluting materials used.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, May 12th, 1883.

Prof. CLIFTON, President, in the Chair.

New Member, Mr. A. W. Soward.

Mr. WOODWARD described "*An Experiment Illustrating Motion produced by Diffusion.*" A porous reservoir of clay containing air was suspended from one end of a weighted balance beam. A glass tube projected from it below and dipped into a vessel of water. A jet of hydrogen gas was allowed to play on the outside of the reservoir, and the balance beam began to oscillate. This is an adaptation of Graham's well-known experiment, and is, in fact, a diffusion engine.

Prof. ADAMS explained the action by the variations of pressure in the reservoir set up by diffusion.

Mr. W. LANT CARPENTER read a paper on "*Some Uses of a New Projection Lantern.*" This lantern, of German make, is supplied by Mr. Paterson, and is simple in construction, cheap, and gives a good image visible to a large audience. It can be used with a three-wick oil lamp or the lime-light. Mr. Carpenter showed a number of objects on the screen.

Mr. LECKY and Mr. WOODWARD offered some remarks, the latter deprecating a too frequent use of projection with students.

Dr. C. R. ALDER WRIGHT read a paper on the "*Electromotive Force of Clark's Mercurous Sulphate Cell, and the Work Done during Electrolysis.*" He described the best mode of constructing Clark's standard cell. According to numerous tests these cells vary in E.M.F. about 0.2 per cent + or - among themselves. A cell properly made will keep its value for about two years. It is of great importance that the cell should not be worked or the current reversed through it, otherwise it may permanently deteriorate. The extraction of air from the paste is not very essential, and boiling it is unnecessary. It is more important that the solution of zinc sulphate should be saturated. Dr. Wright described a cell in vacuum, which is a good standard. He found the E.M.F. to vary 0.4 between 0° and 100° C. With regard to the work done in a cell, among other interesting deductions he found that in a secondary battery the larger the plates the greater the economy. In the electrolysis of water, the greater the surface-condensing power of the electrodes for gas the less difference of potential is required to decompose the water. Thus with platinum electrodes a lower E.M.F. serves for the electrolysis than with gold electrodes.

Prof. FOSTER then took the chair, and

Prof. CLIFTON read a paper on a "*Complete Determination of a Double Convex Lens by Lineal Measurements on the Optical Bench.*" This was a method (somewhat similar to that of Mr. Boys previously described to the Society) for determining the four quantities of a lens on the bench by lineal measures, and without the use of the spherometer and prism. Experiment showed that it was as about as accurate as the spherometer method.

NOTICES OF BOOKS.

A Manual of Photographic Chemistry, Theoretical and Practical. By Rev. T. F. HARDWICH, M.A. Ninth Edition. Edited by J. TRAILL TAYLOR. London: J. and A. Churchill.

THE title of this work does by no means fully and adequately indicate its contents. In addition to photographic chemistry it contains two chapters treating on the optics of the art, and no inconsiderable amount of

matter which comes under the head of practical instruction rather than under that of chemical principles. These portions of course must add to rather than detract from the value of the book as a photographer's manual, but they are not indicated in the title.

Among the changes introduced in the present edition is the introduction of the modern atomic weights of the simple bodies, and the nomenclature of their compounds. The editor remarks with much reason that he did not consider it judicious entirely to discard the old nomenclature in favour of the new. The old system is in fact still largely in use not merely among photographers, but among well-nigh all classes of persons practically engaged in the chemical arts. But we should suggest that the best way of introducing the new names would be to place them in parentheses after their older synonyms, or else to invert this arrangement.

In the table of elementary bodies we find the more than questionable Davy, whilst scandium, ytterbium, terbium, and thulium do not appear. In the table of symbols and molecular weights of the principal compounds used in photographic practice, we find a few irregularities. Thus the author speaks of potassium nitrate, sodium nitrate, but instead of "barium nitrate," he retains "baryta, nitrate of." He writes, conformably with modern usage, "ammonium bromide, chloride, iodide," &c., but, suddenly returning to the old nomenclature, he puts "ammonium, sulphocyanide of." This irregularity, we fear, will prove somewhat confusing.

In the section on the chemistry of organic compounds we find the doctrine of dualism still asserted. It is written: "Inorganic bodies, as already shown, unite in pairs—two elements join to form a binary compound; two binary compounds produce a salt; two salts associated together form a double salt." This view is not now accepted as orthodox. Speaking of organic compounds, the author says: "The bases are also a large class. Morphia, obtained from opium; quinia, from quinine; nicotine, from tobacco, are illustrations." This passage conveys the impression that quinine, instead of being a synonym for quinia, is a raw material, like opium and tobacco.

There is here also some repetition which might be avoided. In Chapter II. we have a "Vocabulary of Photographic Chemicals" with an account of the silver bromide, iodide, chloride, nitrate, &c. But the next chapter is devoted to "The Salts of Silver employed in Photography," and contains to some extent the same matter which occurs in the foregoing chapter.

Chapter IV. gives an account of the various substances used as reducing agents, and here again we find information which has already figured in Chapter II. Under "Fixing Agents," in Chapter V., we also notice some repetitions. In short, we must take the liberty of saying that the earlier chapters of the work stand in need of a thorough revision.

In the succeeding chapters, which deal more with the practical part of the subject, the author and editor have felt more at home. The description of the gelatine emulsion process is here a very important addition. But, as the editor expressly mentions, it would be a great mistake to consider the collodion process as superseded. On the contrary, the demand for collodion, according to the testimony of one of the largest makers, is more extensive than ever. The chapter on the optics of photography is highly satisfactory. In short, there is needed merely a revision of the earlier chapters to render the work practically unexceptionable.

The Geological Record for 1878. An account of Works on Geology, Mineralogy, and Palæontology Published during the Year, with Supplements for 1874—1877. Edited by W. WHITTAKER, B.A., F.G.S. London: Taylor and Francis.

THE appearance of this volume has been delayed in part by the great increase in the quantity of geological work

to be summarised, but still more to the non-arrival of the MS. for the sections America and Arctic Regions. The present volume, as before, is divided into sections dealing respectively with stratigraphical and descriptive geology, physical geology, applied and economic geology, petrology (including meteorites), mineralogy, with mineral waters, palæontology, maps and sections, and miscellaneous matter. There are also important supplements, addenda, and indices.

In the stratigraphical and descriptive portion we still notice the paucity of work in Asia, Australia, and still more in Africa and Oceania. This deficiency is of course not the fault of the zealous editor and his coadjutors.

Under the head Physical Geology we find notice of a memoir by Sir G. Airy on the probable condition of the earth's interior, in which he suggests that portions of the entire mass of the planet differ respectively very much in density. There is also an abstract of Dr. Croll's theory of the origin of nebulae and the cause of solar heat, which he ascribes to the collision of two bodies moving in space with great velocity. Mr. G. H. Darwin thinks that Europe and Asia might have been elevated in less than 20,000 years and yet leave no record in the present motion of the earth, and that Haughton's method fails to give a clue to the question of geological time. Prof. J. A. Church finds that the well-known excessive heat of the Comstock Mine has no relation to fixed levels, but is due to chemical action going on in the rocks. Mr. H. Hennessy shows that the reasonings of Sir W. Thomson and Mr. G. H. Darwin on the tidal action of an internal fluid on its shell are vitiated by the assumption of an incompressible fluid and an elastic, and therefore compressible, solid. A highly compressible liquid contained in a much less compressible shell would be a hypothesis more in harmony with observation. Hence the objections raised to the idea of an internal incandescent fluid do not hold good. Dr. A. Streng maintains that the interior of the earth may consist of a solid nucleus with a succession of alternate liquid and solid shells between this nucleus and the outer crust. Prof. J. Young asks how it is possible that 100 feet of till could accumulate under an ice-sheet some 2000 feet thick? C. Ochsensius discusses the origin of gypsum as a common associate of rock-salt. A gulf cut off from the open sea by a bar favours deposition of salt free from gypsum. Small proportions of sulphate of lime in salt deposits may be due to the high temperature of the water. Mud falls rapidly from warm concentrated saline solutions.

Prof. A. Cossa describes a potash-alum from the Isle of Volcano containing thallium, rubidium, and caesium.

H. Hauenschild gives details as to an exact experimental reproduction of the characteristic surface-hollows of meteorites by means of streams of air directed at a great velocity upon red-hot matter.

A relatively considerable space is devoted to mineral waters. The rehabilitation of these liquids in England—not merely as medicines, but as ordinary beverages—is a striking instance of what may be effected by persistent advertising.

Not alone geologists, in the strict sense of the word, but many persons devoted to other sciences or to industrial arts will find the Geological Record a most useful work of reference.

A Manual of Chemical Analysis, as applied to the Examination of Medicinal Chemicals. A Guide for the Determination of their Identity and Quality, and for the Detection of Impurities and Adulterations. Third Edition, thoroughly revised and greatly enlarged. By F. HOFFMANN, Ph.D., Public Analyst to the State of New York, and F. B. POWER, Ph.D., Professor of Analytical Chemistry in the Philadelphia College of Pharmacy. Philadelphia: H. C. Lea's, Son, and Co.

AMONG the special branches of chemical analysis none is more important than that which relates to pharmaceutical preparations. Their great and increasing num-

ber, the frequent adulterations, or at least impurities, to which they are liable, and the importance which attaches to their purity, all render the work before us valuable and necessary. It must be borne in mind that the authors in this treatise take into consideration definite chemical compounds only. The crude natural products used in medicine, gums, resins, fatty oils, roots, &c., and their solutions or extracts are left unnoticed.

The work opens with an abridged treatise on qualitative analysis. The authors treat in succession of operations and apparatus, of reagents and test solutions; of the preliminary examination of an unknown substance, the systematic search for bases and acids; of volumetric analysis; of the general characters of the alkaloids, with a scheme for their systematic separation and detection. The principal properties of the ptomaines are stated, but their distinction from the vegetable bases is regarded as a yet unsolved problem.

The second and main portion of the book treats of the medicinal chemical compounds in alphabetical order. Under each we find its Latin name as used by English and American pharmacists, its German-Latin pharmaceutical name, often perplexingly unlike the former, and its pure chemical name in English, German, French, and Spanish. The most objectionable feature of the Latin nomenclature of the *Pharmacopœia Germanica* is that it gives to the bromides, iodides, chlorides, &c., names which seem to belong to the bromates, iodates, and chlorates. Thus the substance known as ammonium bromide, becomes, in the language of German pharmacy, "ammonium bromatum."

Beneath the names of each compound follows its formula, experimental and theoretical, and its molecular weight. Then follow its principal properties, its reactions, solubilities, the impurities most apt to be present, indications for their detection, and, whenever requisite, the quantitative valuation of the sample. It need scarcely be said that the instructions given, though primarily intended for pharmacutists, are in numbers of cases no less valuable to the scientific and to the industrial chemist. In almost all cases we are happy to recognise here a most gratifying degree of thoroughness. Among the few omissions which we perceive is the possible occurrence of selenium in sulphuric acid.

As an appendix follows a series of tables. That of the atomic weights of the elementary bodies gives the most recent determinations, e.g., the corrected weight of platinum. There are also tables showing the equivalence of the Centigrade and Fahrenheit thermometric scales, from -40° to $+430^{\circ}$ of the former, for converting metric measures of capacity into United States fluid measures, among which latter the grain measure does not seem to be included, and for converting metric weights into troy weight.

The work is throughout usefully illustrated, not merely with drawings of apparatus, but also with diagrams of the forms of crystals when calculated to aid in the recognition of compounds.

Death of Dr. James Young.—We greatly regret to learn the death of Dr. James Young, of Kelly, the founder of the paraffin manufacture, and one of our most eminent and successful industrial chemists. He died on the night of Sunday, the 13th inst., aged seventy-one. We shall give next week a sketch of the life of our deceased friend.

Prevention of Fires.—A public meeting will be held at the Society of Arts on the subject of the prevention of fires in theatres. The report of a committee of the Society, which has for some time been investigating the question, will be brought before this meeting for its consideration. The precise date has not yet been decided, but it will be held the end of the present month. Further particulars will appear in future numbers of the Society of Arts' Journal.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 17, April 23, 1883.

Certain Relations between the Temperatures of Combustion, Specific Heats, Dissociation, and the Pressure of Explosive Mixtures.—M. Berthelot.—A thermo-chemical paper, not capable of useful abridgment.

Study of the Ultra-Red Radiations by Means of the Phenomena of Phosphorescence.—H. Becquerel.—(See p. 225).

Variation of the Refraction Indices of Water and of Quartz under the Influence of Temperature.—H. Dufet.—The author expresses his results in the form of tables.

Liquefaction of Nitrogen.—S. Wroblewski and K. Olszewski.—Having liquefied oxygen in a complete manner we proceeded to nitrogen. This gas, cooled in a glass tube down to -136° and submitted to a pressure of 150 atmospheres, still remained gaseous, and nothing could be seen in the tube. If suddenly released there is in the whole tube a tumultuous ebullition, comparable only with the ebullition of liquefied carbonic acid in a Natterer's glass tube, when plunged into water at a temperature a little higher than the critical point of carbonic acid. But if the release is effected slowly, and if the pressure whilst being reduced is not allowed to go beyond 50 atmospheres, the nitrogen is completely liquefied, presenting a very distinct meniscus, and evaporating rapidly. Thus nitrogen only remains for a few seconds in the static condition of stable liquids. In order to keep it longer in this state a temperature would be required lower than the minimum hitherto produced. Such a temperature the authors are seeking to obtain. Liquid nitrogen is colourless and transparent, like oxygen and carbon dioxide. The authors add that they have since liquefied carbon monoxide in the same manner, obtaining a colourless liquid, which shows a distinct meniscus.

Iodised Apatites.—A. Ditte.—The author sums up his results to the effect that the apatites and wagnerites form well-defined groups of compounds, presenting the same composition and the same crystalline forms. These bodies may indifferently contain chlorine, bromine, iodine, fluorine; they take rise by the dry way under circumstances quite analogous, and their decomposition is subject to the same laws.

The Action of Water upon the Lime of Theil, and the Existence of a New Hydraulic Compound, Pozzo-Portland.—E. Landrin.—The new compound in question is formed when hydraulic silica absorbs lime. It tends towards a limit expressed by $3\text{SiO}_2, 4\text{CaO}$.

Certain Phenolic Derivatives.—L. Henry.—The compounds in question are the oxide of mono-chlorophenyl-ethyl, phenyl-ethyl-oxylic ethylene, mono-bromophenyl-allyl oxide, and propargylic phenol.

Moniteur Scientifique, Quesneville.
April, 1883.

Present State of the Alkali Manufacture.—Walter Weldon.—From the *Journal of the Society of Chemical Industry*.

Patents concerning Artificial Colouring-Matters.—M. Gerber.—A series of specifications, chiefly of German origin.

Salicylic Medication in the Treatment of Typhoid Fever.—M. Vulpian.—A purely medical paper.

Present State of the Sulphur Trade in Italy.—M. Gerber.—An account of the geographical and geological distribution of sulphur deposits in Italy, its separation from the gangue, and its exportation.

Review of Foreign Chemical Researches.—G. de Becchi and H. Gall.—Extracts from the leading German chemical papers.

Industrial Society of Mulhouse.—Session of Feb. 14, 1883.—M. A. Scheurer presented, on behalf of M. A. Pabst, a memoir on the theory of the formation of compound ethers.

The Secretary announced that a memoir on the theory of Turkey-red dyeing had been received in candidature for prize No. 1 of the chemical arts.

M. H. Kœchlin read a memoir on the gallo-cyanines, already noticed.

M. Camille Kœchlin gave some interesting details concerning Turkey-red dyeing on the old system. The modification of the oil upon the fibre, from exposure on grass, takes place only under the influence of light. If a part of the cloth is covered, the oil on such part undergoes no change.

M. Saussure had observed that oil exposed to light may absorb 300 to 400 times its volume of oxygen. However little it may have been once rendered sensitive by the action of the sun, the absorption of oxygen with liberation of heat continues afterwards in the dark. In consequence of this phenomenon it is necessary to moisten or to air the cloth after the exposure on grass to prevent ignition. Linseed oil possesses this property in the highest degree. Oil which has been exposed to the sun or to a high temperature decomposes aluminous mordants, and the transformation which it has undergone may be measured by the quantity of mordant which it takes up. The absorption of oxygen, which demands precautions against spontaneous combustion, does not determine the condition of oiling. From a tinctorial point of view it remains a secondary reaction, for the red colour may be completed more rapidly than this process of absorption, or the latter may be continued to saturation without the shade manifesting any sensibility to what is going on. During insolation the glycerin is set free from the oil. To assist in this change oils are used in which a part of the oleic acid has been already set at liberty by fermentation. These oils, known as emulsive oils, form with the alkaline carbonates, emulsions, in which the oil does not rise up to the surface. The more these emulsions or white baths are alkaline the more readily they are acted on by light or heat, but the more the fatty compound retains its solubility. In practice the proportions are regulated by the weather and the arrangement of the stoves. The dyers were accustomed to add sheep's dung to the white baths, which, by its albuminous nature, strengthened the organic mordant. For the action of light may be substituted that of heat. The procedures based upon this substitution have the advantage of being independent of the weather, and of reducing the operations of applying the oil. These operations may consist of a single strong white bath or of a passage in pure hot oil. The cloth is then stoved at 80° , 100° , or 135° according to the duration of the process; 80° for stoving for several hours, or 135° for hot flues. Cloth steeped in pure oil takes a sulphur-yellow colour, followed by a darker and darker yellow, which passes into a brown, and finally into a black. The oil may be carbonised before the fibre. The action is best arrested at a nankin shade. This process is followed by some passages in alkaline water, drying between. The absorption of oxygen is more rapid and dangerous than after exposure to the sun; the cloth must be speedily spread out to prevent accidents. Pieces treated with linseed oil become carbonised if left rolled up or in heaps whilst moist. An oil which has been heated to 150° , 200° , 250° , 300° , and is then applied to cloth, absorbs oxygen immediately in its fine state of division. The absorption is the more energetic the more

strongly the oil has been heated. The final product is a solid resin. Charles Steiner, of Church, Lancashire, devised a process not requiring exposure on grass. This process, which introduced regularity into the numerous operations, as well as the red of MM. Braun and Cordier, was an intermediate step between the ancient process, and that with hydrated oleic acid, due to M. H. Kœchlin. In this process exposure to the sun or to heat is dispensed with, and accidents of spontaneous combustion or heating are not to be dreaded, the oxidation taking place slowly. It was formerly supposed that oiling animalised the fibres, and gave them transparency,—suppositions as contrary to chemical as to practical conditions. Though oiled tissues have the property of attracting the majority of soluble colouring-matters, like the salts of the oxides capable of acting as mordants, and of rendering colours more permanent, Turkey-red is, in fine, merely a madder-red, produced upon tissues in which oleic acid has been fixed.

M. Albert Scheurer stated that heating to 120° with hot water is sufficient to clear Turkey-reds which have been dyed in presence of a sulpholeate.

M. H. Kœchlin had observed that pieces cleared with 1-rooth nitro-muriate of tin had spots of mould after the lapse of three or four months. Analogous accidents are still produced under other circumstances, and seem to occur generally when the pieces have been taken through an acid liquid before drying.

M. A. Scheurer is of opinion that clearing Turkey-reds consists in a dehydration of the alumina combined with a fatty body. M. Scheurer finds that the temperature at which water produces on a dyed swatch the highest degree of brightness (120° applied for two hours) is exactly that at which the mordant of another swatch prepared under the same conditions, but not dyed, is entirely dehydrated. The dehydrated mordants are with difficulty attacked by acids, and no longer possess the property of attracting colouring-matters. Clearing depends as much or perhaps more on the temperature to which the tissue is heated along with water as on the nature of the substances added.

M. Noelting, in his own name and in that of M. Wild, informed the Society that on causing ethyl-phenyl-nitrosamine to react upon aniline hydrochlorate in presence of an excess of aniline, ethyl-amido-azobenzol is formed, without secondary products.

MM. Noelting and Kohn, in order to complete their studies on the azo-derivatives of cresylol, have prepared the compounds of diazobenzol and of diazophenyl-sulphonic acid upon ortho- and meta-cresylol. The derivatives of ortho-cresylol yield, on reduction, a paramido-ortho-cresylol, transformable into toluquinone. The same amido-cresylol is also obtained by the reduction of nitroso-ortho-cresylol prepared by the action of nitrosyl sulphate upon ortho-cresylol. The reduction-products of the azo-derivatives of meta-cresylol are under examination.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xii., Part 3.

Manurial Experiments on Sugar Beets on the Sierakowo Estate in 1882.—A. Tschuschke.—This paper does not admit of useful abstraction.

Changes in the Milk-Secretion under the Influence of certain Medicines.—Dr. Stumpf.—From experiments with goats it was found that small doses of potassium iodide produced an increase of fatty matter and of sugar, with little change in the albumenoids and saline matter. The reaction of the milk, which had been previously amphoteric, became alkaline, and remained so for seven days after the administration of iodine had ceased. Small doses of lead had no appreciable effect upon the quality and quantity of the milk. Morphine had no appreciable effect. Pure ethylic alcohol diluted with water produced

no effect upon the quality of the milk; the solids increased, and the specific gravity decreased. The effects of beer were similar. A goat received daily 2 litres. The sugar and fatty matter in her milk were notably increased.

The Extirpation of Field-Mice.—Dr. Joseph and Dr. Crampe.—A fatal cutaneous disease is produced in rodents by the so-called "favus fungus" (*Achorion Schœnlinii*). The authors propose to apply this fungus to the skin of captured specimens, and then turn them loose to spread the infection.

Cosmos Les Mondes.

No. 15, April 14, 1883.

Preservation of Honey.—E. Mylius.—Crude honey is found to keep better than that which has been clarified. The author recommends the addition of 1 per cent of oxalic acid, which prevents fermentation without injuring the taste of the honey.

Combination-Heat of Glycolates.—Dr. D. Tommasi.—Already noticed.

No. 17, April 28, 1883.

Hydrogen and Antiseptic. The Egasse System.—The author proposes to dissolve zinc in hydrochloric acid, to sell the hydrogen gas for filling balloons, &c., and to utilise the zinc chloride as a disinfectant. (From the general tone of the article it would almost seem that the "inventor" considers this a novel application (!).

Archives Neerlandaises des Sciences Exactes et Naturelles,
Tome xvii., Livraison 3me.

Osmosis of Salts considered in Relation with the Constitution of Solutions.—J. E. Enklaar.—The principal results laid down are that in a mixture of salts each preserves, in the common solution, its own osmotic speed; in other words they pass independently of each other from the common solution, through the membrane, into pure water. But when sodium chloride and hydrochloric acid pass from a common solution through a membrane into pure water, their osmotic velocities are lower than when separately submitted to osmosis. The influence exerted by hydrochloric acid upon the speed of the osmotic current of sodium chloride varies but little with the quantity of the acid. The author gives the caution that in series of osmotic experiments the bladders used should be obtained from animals of the same species and of the same age.

Tome xvii., Part 5.

Specific Rotatory Power of Apocinchonine and Hydrochlor-apocinchonine under the Influence of Acids.—A. C. Oudemans, Jr.—The author gives his results in tables not capable of abridgment.

MEETINGS FOR THE WEEK.

- TUESDAY, 22nd.—Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8.30.
— Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
WEDNESDAY, 23rd.—Society of Arts, 8.
— Geological, 8.
THURSDAY, 24th.—Royal Institution, 3. "Recent Discoveries in Egypt," by Mr. R. S. Poole.
— Royal, 4.30.
— Philosophical Club, 6.30.
FRIDAY, 25th.—Royal Institution, 8. "Whales," by Prof. Turner, 9.
— Quckett Club, 8.
SATURDAY, 26th.—Royal Institution, 3. "Russian Social Life," by Prof. Turner.
— Physical, 3. "On the Graphical Representation of Musical Intervals," by G. Griffiths. "On a Phenomenon of Molecular Radiation in Incandescent Lamps," by J. A. Fleming.

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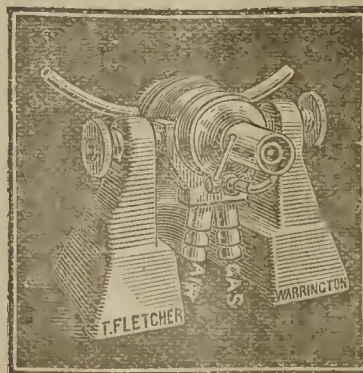
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THE CHEMICAL NEWS.

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ON AN AMMONIO-PHOSPHATIC DEPOSIT IN THE VICINITY OF CAPE TOWN.

By A. B. GRIFFITHS, F.C.S., &c.

THIS deposit was found some time ago in some caves, a few miles to the south-east of Cape Town, South Africa. The deposit is in a powdered condition, and of a brown colour, but contains solid nodules. These nodules present the appearance of contortions like ordinary guanos; and, when reduced to powder, and washed in distilled water, and the sediment treated with acids, followed by washing in water in the usual way, a microscopical examination showed that these nodules contained a large amount of diatomaceæ, and a few sponge spicules. The powder-deposit also showed the presence of diatomaceæ. On submitting a fair sample of the deposit to analysis, it was found to contain:—70·21 per cent of ammonium compounds, 17·5 per cent of phosphates, 3·3 per cent of nitrogen, &c. Probably these deposits may furnish a very useful manure.

From these observations it is most probable that these deposits consist of the more or less altered excrementitious matters of an extinct fauna.

RE-HYDRATION OF FERRIC OXIDE.

By C. F. CROSS.

I TAKE this opportunity of recording the results of a six months' observation of the re-hydration of the ferric *mono-dehydrate*, using this expression for the composition of the oxide obtained by drying the ordinary precipitate hydrate at 100°.

The specimen used in these experiments lost 9·7 p. ct. on ignition $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O} = 10 \cdot 1$ per cent.

The method adopted was that involving the use of the spiral balance, the disposition of the substance, and the mode of weighing in the saturated atmosphere, as described in a previous communication (CHEMICAL NEWS, vol. xlv., 101).

The numbers represent m.m. of extension. The substance was evenly distributed over a circular area of 70 m.m. diameter:—

	A. (1 grm. = 133·5 m.m.)	B. (1 grm. = 135 m.m.)	Time.	Temp.
			Hours.	
May 19	80	70	0	18°
"	94	82	18	16
"	94	82·5	23	18
"	96	84	43	18
"	96	84	47	20
" ($\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$)	97	85	67	18·5
"	97	85	91	18
"	97	85	115	17
"	97	86	164	18·5
"	97·5	86	215	22
"	97·5	86	264	18
			Days.	
"	97·5	86	13	18
"	97·5	86·5	18	19
"	100·5	88·5	38	18
"	107	95	57	17
"	160	145	173	15
Nov. 27 ($\text{Fe}_3\text{O}_3 \cdot 11\text{H}_2\text{O}$)	160	145	192	15

These numbers explain themselves. In order to investigate the stability of this dehydrate, B was exposed to the ordinary atmosphere, and weighed at intervals with the following results:—

B.	m.m.	After 15 mins. exposure	Temp.
145	"	30	11
145	"	45	11
142·5	"	2½ hours	11
142	"	3	12
141·5	"	46	10
141·5	"	70	11
142	"	6 days	10

These numbers express the permanence of the new hydrate and its freedom from hygroscopic water.

The course of re-hydration of ferric oxide is thus an interrupted and extremely gradual progression towards a high limit, which it is perhaps impossible to fix by observation as it would represent the state of equilibrium of a large number of conditions, each difficult of control. It is interesting to notice that a long interruption of the re-hydration occurs at the point $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$. Parallel with the series A and B, which were conducted in a room with a northern aspect, observations were made with instruments placed in a conservatory with a southern aspect. The results are given under C and D: the conditions were precisely similar to those of A and B.

C. (1 grm. = 125 m.m.)	D. (1 grm. = 129 m.m.)	Time.	Temp.
85	88	0 hours.	22°
94·5	99	18 "	20·5
97	101	23 "	25·5
94	99	43 "	23·5
97	101	47 "	28
93·5	98	67 "	25·5
94	98·5	91 "	19·5
94·5	99	115 "	16·5
95·5	100·5	215 "	27

The observations were broken off at this stage, as it was found that the large daily fluctuations in temperature caused considerable disturbance from the consequent evaporations and condensations of water, from and upon the portion enclosed in the saturated atmosphere. These results show a lesser rate of progress of the re-hydration under conditions which might be presumed to be more favourable; and this is their only value. On the other hand, the uniformity of the numbers obtained under A and B is sufficient evidence of the trustworthiness of the method under suitable and regulated conditions.

ON A NEW TEST FOR DETECTING ALBUMEN IN URINE.

By ARTHUR R. HASLAM.

WHILE recently engaged in some experiments, I had occasion to add a solution of chloride of iron to a diluted solution of albumen, into which, some time previously, a small quantity of chloride of sodium had been thrown. The result was the formation of a dense opaque white precipitate. This precipitate, when well washed and dried, still contained iron, from which circumstance I should suppose it to be a compound of albumen and iron.

I have experimented on this reaction as a test for albumen, especially for that form which it assumes in urine, and it appears certain in its results, and has some advantages in its favour over the old nitric acid test, being much more delicate.

After a series of experiments, I have adopted the following method of using the test:—A portion of the urine

supposed to contain albumen is poured into a test-tube, and a few drops of a solution of chloride of sodium added, and well mixed; then a solution of chloride of iron is carefully poured down the tube, forming a layer. If the appearance of a whitish cone be noticed, albumen is present. If phosphates are present in the urine, care must be taken to add (before using the test) sufficient acetic acid to make the urine acid.

May 19, 1883.

DETERMINATION OF THE CINCHONA ALKALOIDS.

PROLLIUS shakes up 5 grammes powdered bark with a mixture of 38 parts alcohol, 10 parts chloroform, and 2 parts ammonia in a stoppered flask; decants off the liquid after some hours as clear as possible, and mixes them with 5 parts finely powdered hydrate of lime, which at once decolourises the vinous red liquid, whilst the alkaloids remain in solution. The liquid is filtered, weighed, and gradually evaporated, when the quinine remains in a varnish-like state, but the other alkaloids as crystals. The weight of the residue gives the percentage of the bark in alkaloids.

For determining the quinine and the secondary alkaloids soluble in ether, Prollius recommends a mixture of 88 parts ether, 4 parts ammonia, and 8 parts alcohol. Three grms. of powdered bark are digested for some hours with 30 grammes of this mixture, shaking frequently. After the powder has settled, 20 grammes of the solution are decanted clear off, and shaken up with 5 to 6 drops of dilute sulphuric acid, or so much that it slightly predominates. The alkaloids settle to the bottom of the vessel as an acid, thick-flowing, aqueous solution. The ether is decanted off, and the residue of the alkaloids is removed from it by agitation, first with 2 grammes and then with 1 gramme ammonia. The united solutions of the latter are heated to expel the alcohol, and are precipitated, whilst warm, in tared capsules, with ammonia. The precipitate is deposited in a resinous state, and is easily washed and dried.

According to H. Kissel the last-described process is especially adapted for the rapid and accurate determination of the cinchona alkaloids, but it shows not merely the quinine and accompanying bases, but the entire alkaloids in the bark. Kissel macerates the bark with the solvent mixture for two hours, evaporates a clear aliquot part of the solution, re-dissolves the residue with a slight excess of dilute sulphuric acid and hot water, filters from the undissolved wax and quinine acid, precipitates when cold with caustic soda, collects on a tared filter, dries at 115° , and weighs.

J. E. de Vrij admits the advantages of the Prollius process, but modifies it by macerating 10 grammes of very finely powdered bark with 200 grammes of the solvent mixture, shaking up frequently, pours off, and weighs a part of the clear liquid; distils off the ether in a water-bath, and rinses the residue with alcohol into a tared capsule. By drying on the water-bath we obtain the crude alkaloids. These are purified by solution in dilute hydrochloric acid, filtered, and the filter is washed till the washings are no longer rendered turbid by soda-lye. The filtrate is shaken up with chloroform and soda-lye in a separating funnel provided with a stopper and a flask. After twelve hours the stratum of chloroform which contains all the alkaloids is drawn off, the chloroform is expelled by evaporation or distillation, the residue is dissolved in alcohol, evaporated in tared capsules, dried, and the pure alkaloids are weighed.

J. Biel macerates 20 grammes powdered bark with 200 grammes of the solvent mixture for four hours in a well-closed flask, filters rapidly through a folded filter covered with a glass plate, and decolourises the solution, if red,

with 20 grammes of finely ground hydrate of lime. One hundred grammes of the filtrate are evaporated to dryness in a beaker on the water-bath, the residue dissolved with a few drops of sulphuric acid and hot water, let cool, filtered, and the filter washed. The total filtrate (about 40 c.c.) is supersaturated with ammonia in a narrow stoppered glass, and four times shaken up with chloroform, using 20 c.c. each time. The chloroform is separated from the aqueous solution by means of a separating funnel, evaporated in the beaker, the residue dried at 110° , and weighed. For accurate determinations the alkaloids must be re-dissolved in dilute acetic acid, filtered through a weighed filter, and the residual resin weighed after drying at 110° , and deducted. The process first given by Prollius yields, according to Biel, the alkaloids in a very impure state, and does not even extract their total quantity.—*Zeitschrift für Analytische Chemie*.

VERY SENSITIVE REACTIONS OF THE SALTS OF IRIDIUM.

By M. LECOQ DE BOISBAUDRAN.

HAVING been recently occupied with the separation of iridium from gallium, the author found the want of distinct characters permitting the identification of traces of iridium carried down by the galliferous products obtained. After many trials he has selected the following reactions, the extreme delicacy of which seems likely to be useful in the analysis of the compounds of iridium:—

(a.) The iridium solution (chloride or sulphate) is mixed with an excess of sulphuric acid and evaporated until white fumes are produced. Or the salt of iridium may be at once mixed with an excess of potassium bisulphate. The mass is placed in a gold capsule, heated to dull redness, and kept at that heat for some minutes. If the proportion of iridium is not too great, hot water entirely dissolves the mass, yielding a liquid generally green, but sometimes blue or violet. In concentrated solutions there is deposited, on cooling, a crystalline powder, of a deep green, containing iridium, potassium, and sulphuric acid. This salt, which forms a clear solution with pure water, or water acidulated with sulphuric acid, is precipitated by neutral potassium sulphate.

Without having need to separate the various salts deposited, the liquid is almost neutralised with potassa or ammonia, taking care to keep the liquid cold and leaving it slightly acid to a degree very perceptible to litmus. Much potassium sulphate is precipitated, carrying down with it the larger part of the iridium, and having a pale green colour. The salts are collected on a filter and roughly washed with a solution of neutral potassium sulphate. The liquid and the washings are collected, and on boiling for 15 to 30 minutes, the green, blue, or violet salts of iridium are transformed into a compound, the base of which is completely precipitated, especially on boiling, by an excess of potassa or ammonia, and re-dissolves in dilute sulphuric acid with a rich violet colour, which appears rose in a very dilute solution.

Iridiferous potassium sulphate dissolved in hot water slightly acidified with sulphuric acid gives with potassa or ammonia the same oxide which dissolves in dilute sulphuric acid, with a violet colour.

It is to be remarked that if the boiled liquid is but very feebly acid, the oxide separates out to a very great extent before the addition of alkali. It is then not readily re-dissolved by dilute sulphuric acid, and has to be boiled with this reagent to bring it into solution.

In searching for traces of iridium it is useless to treat separately the iridiferous potassium sulphate. It must be boiled immediately after the approximate neutralisation.

If it is suspected that the process has not been well conducted, if, e.g., the alkaline filtrate has a feeble rose

colour, the liquid is evaporated to dryness, sulphuric acid is added, the whole heated to redness, and treated as above.

In this manner we may separate and detect 1-40th m.grm. iridium (taken in the state of chloride or sulphate) in 50 grms. (two million times its weight) of potassium bisulphate. The precipitation by alkali takes place in a volume of 400 c.c., so that the insolubility of the violet oxide is almost absolute.

For very feeble traces of iridium the violet colour may be masked by the presence of iron salts derived from the filters or the reagents. In this case the solution is neutralised with ammonia, mixed with ammonium hydrosulphate, kept for some time at a gentle heat, filtered, and evaporated almost to dryness. By boiling with aqua regia the ammoniacal salts are destroyed, the sulphur clots together, and the iridium is characterised by the tint of its tetrachloride, the colouring-power of which is decidedly greater than that of the violet sulphate. It is better, however, to apply to the product of the treatment with aqua regia the following reactions *b* and *c*, the sensitiveness of which is extreme.

(*b*.) We add to the salt of iridium (chloride or sulphate) a small excess of sulphuric acid, and heat until a portion of the acid is expelled, so as to drive off the hydrochloric acid—an important point. The capsule is then withdrawn from the fire, and at the moment when the sulphuric fumes cease to be abundant, we add ammonium nitrate in small portions. The capsule is then restored to a moderate fire, and the introduction of the nitrate is continued. There is thus produced a splendid blue colour of such intensity that it may be distinctly obtained with 0.001 m.grm. iridium. When the reaction is complete the capsule is withdrawn from the fire whilst a little of the nitrate is still undergoing decomposition. The blue matter dissolves in water, retaining its colouration.

Sometimes the assay, instead of an indigo-blue, appears of a rich emerald green. It is sufficient to let it cool, drop a little sulphuric acid upon the mass, and heat again, when the colour changes to a pure blue.

An admixture of foreign metals reduces the delicacy of the reaction, which is, however, very useful in presence of gold, ruthenium, platinum, and rhodium. The blue colouration is, of course, modified by the peculiar colourations given by some of the metals subjected to the same conditions. Thus, with a mixture of gold and iridium we obtain a green.

(*c*.) If, instead of expelling the hydrochloric acid by prolonged heating with sulphuric acid, we add at the outset (simultaneously, or rather successively, at short intervals) ammonium nitrate and hydrochlorate, there is formed not the blue matter, but the assay takes a rose colour. An excess of ammoniacal salts destroys, in part, this colour, which reappears on adding a little sulphuric acid and heating. The best process is to throw into the hot sulphuric acid at first ammonium chloride, and shortly afterwards the nitrate, withdrawing the whole from the fire whilst a little of the ammoniacal salts remains undecomposed. The mass on treatment with very little water leaves a rose-coloured powder, soluble in pure water, but insoluble in a saturated solution of ammonium bisulphate. The aqueous liquid appears to contain ordinary ammonium chloro-iridate.

The present reaction can be produced with 0.001 m.grm. iridium.

By combining the process *a* with the reactions *b* and *c*, it is easy to separate and to recognise with certainty 0.01 m.grm. iridium in two million times its weight potassium bisulphate.—*Comptes Rendus*.

Amylic Alcohol produced accessorially in Alcoholic Fermentation.—J. A. Le Bel.—The author concludes that natural grape-juice, when fermented, yields more of the higher alcohols than does sugar.—*Comptes Rendus*.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING APRIL 30TH, 1883.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford.

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

London, May 5th, 1883.

SIR,—We beg to submit, for the information of the Local Government Board, a statement of the particular and general results of our examination, made at the expense of the Water Companies, of 175 samples of water, collected by us during the past month at the times and places indicated, from the mains of the seven London companies taking their supply from the Thames and the Lea; together with some observations on a portion of the report, made to the Registrar-General, on the water supply of the preceding month.

We are, Sir,

Your obedient Servants,

WILLIAM CROOKES,
WILLIAM ODLING,
C. MEYMOTT TIDY.

To the Secretary of the Local Government Board.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from April 1st to April 30th inclusive. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted for analysis.

Of the 175 samples of water submitted to examination, the whole without exception were clear, bright, and well filtered; and their condition in respect to aëration and to freedom from colour and excess of organic matter, was unimpeachably excellent.

In the Report to the Registrar-General, on the character of the water supplied to the Metropolis “during the month of March,” it is asserted that the “Grand Junction and Lambeth Companies’ waters were very slightly turbid, and contained moving organisms,” the assertion being based on an examination of a single sample of each Company’s water taken on the 14th day of the month.

The daily samples submitted to examination by ourselves during the month of March were taken, not as usual from the mains, but on this particular occasion, from the filtered water reservoirs of the companies. Thirty-one samples of each of the inculpatated companies’ waters were examined by us with all care, and in no one sample were we able to recognise the presence of turbidity or of any “moving organisms.”

The Report of the Official Water Examiner, with regard to the supply of the Grand Junction Company during the month of March, is as follows:—“Daily samples were taken at the Works, and the water found to be clear, bright, and efficiently filtered;” while his Report with regard to the supply of the Lambeth Company is as follows:—“Daily samples were taken at the Works, and the water found to be generally clear, bright, and efficiently filtered.”

We are, however, quite prepared to admit that among the samples of water, now approaching five thousand in number, examined by us since December, 1880, an occasional sample has been met with in which one or two "moving organisms" were recognisable; but in no case have we found a month's or even a week's supply of any company's water to be chargeable with the presence of "moving organisms."

While not looking upon the occurrence of "moving organisms" in the water supply of a town as otherwise than objectionable, however difficult it may be to ensure from year's end to year's end their absolute exclusion, we think it desirable that the real significance of their presence should not be misunderstood. It seems also to us that in the reports made to the Registrar-General, which not merely set forth the bare analytical results obtained, but profess to explain their import and signification, some statement as to the precise nature of what are so vaguely designated as "moving organisms," and some intimation of their little real importance, might in common fairness be expected from one who, by his persistent use of language which has been reprobated by a Royal Commission, does not a little to create an unfounded prejudice against the water supply on which he is expected impartially to report.

We accept as the expression of our own opinion with regard to "moving organisms" what is stated in the following extracts from a published lecture of Dr. Frankland's, delivered at the Royal Institution in 1861:—"These organisms consist of animalculæ and animals of a larger size. . . . The water supplied to Manchester, which is well known to be one of the best waters in this country, is quite full of this kind of animals in summer. . . . Both of the specimens which I have shown are to be met with in good waters. . . . Looked at from a chemical point of view, they are exceedingly useful in the water. . . . From a physiological point of view, I do not know what sort of a case can be made out against them. . . . The animals themselves cannot pass through the filter, but their ova can."

ELECTRICAL UNITS OF MEASUREMENT.*

By SIR WILLIAM THOMSON, F.R.SS. L. and E., &c.

THE Lecturer began by observing that no real advance could be made in any branch of physical science until practical methods for a numerical reckoning of phenomena were established. The "scale of hardness" for stones and metals used by mineralogists and engineers was alluded to as a mere test in order of merit in respect to a little understood quality, regarding which no scientific principle constituting a foundation for definite measurement had been discovered. Indeed it must be confessed, that the science of strength of materials, so all important in engineering, is but little advanced, and the part of it relating to the quality known as hardness least of all.

In the last century Cavendish and Coulomb made the first advances towards a system of measurement in electrical science, and rapid progress towards a complete foundation of the system was effected by Ampère, Poisson, Green, Gauss, and others. As late as ten years ago, however, regular and systematic measurement in electrical science was almost unknown in the chief physical laboratories of the world; although as early as 1858 a practical beginning of systematic electric measurement had been introduced in the testing of submarine telegraph cables.

A few years have sufficed to change all this, and at this time electric measurements are of daily occurrence, not in our scientific laboratories only, but also in our

workshops and factories where is carried on the manufacture of electric and telegraphic apparatus. Thus, ohms, volts, ampères, coulombs, and micro-farads are now common terms, and measurements in these units are commonly practised to within 1 per cent. of accuracy. It seems, indeed, as if the commercial requirements of the application of electricity to lighting and other uses of everyday life were destined to influence the higher region of scientific investigation with a second impulse, not less important than that given thirty years ago by the requirements of submarine telegraphy.

A first step towards the numerical reckoning of properties of matter is the discovery of a continuously-varying action of some kind, and the means of observing and measuring it in terms of some arbitrary unit or scale division; while the second step is necessarily that of fixing on something absolutely definite as the unit of reckoning.

A short historical sketch was given of the development of scientific measurement, as applied to electricity and magnetism, from its beginning with Cavendish, about 100 years ago, to the adoption of the absolute system of measurement by this country in 1869, at the instance of the British Association Committee on Electric Standards. The importance in this development of the originating works of Gauss and Weber was pointed out, as also of the eight years' labours of the British Association Committee. This Committee not only fairly launched the absolute system for general use, but also effected arrangements for the supply of standards for resistance coils, in terms of a unit, to be as nearly as possible 109 centimetres per second. This unit afterwards received the name of the ohm, which was adopted from a highly suggestive paper which had been communicated to the British Association in 1861, by Mr. Latimer Clark and Sir Charles Bright, in which some very valuable scientific methods and principles of electric measurements were given, and a system of nomenclature—ohms, kilohms, farads, kilofarads, volts, and kilovolts—now universally adopted with only unessential modification, was proposed for a complete system of inter-dependent electric units of measurement. At the International Conference for the determination of Electrical Units, held at Paris in 1882, the absolute system was accepted by France, Germany, and the other European countries; and Clark and Bright's nomenclature was adopted in principle and extended.

Gauss's principle of absolute measurement for magnetism and electricity is merely an extension of the astronomer's method of reckoning mass in terms of what may be called the universal gravitation unit of matter, and the reckoning of force, according to which the unit of force is that force which, acting on unit of mass for unit of time, generates a velocity equal to the unit of velocity. The universal-gravitation unit of mass is such a quantity of matter, that if two quantities, each equal to it, be placed at unit distance apart, the force between them is unity.

Here mass is defined in terms of force and space, and in the preceding definition force was defined in terms of mass, space, and time. Eliminating mass between the two, it will be found that any given force is numerically equal to the fourth power of the velocity with which any mass whatever must revolve round an equal mass, fixed at such a distance from it as to attract it with a force equal to the given force. And, eliminating force between the two primitive definitions of the universal-gravitation system, it will be found that any given mass is numerically equal to the square of the velocity with which a free particle must move to revolve round it in a circle of any radius, multiplied by this radius. Thus, take a centimetre as the unit of length, and a mean solar record as the unit of time, and adopt 5.67 grammes per cubic centimetre as the mean density of the earth from Baily's repetition of Cavendish's experiment, and suppose the length of the seconds' pendulum to be 100 centimetres, and neglect the oblateness of the earth and the centrifugal force of its rotation (being at the equator only $\frac{1}{288}$ of gravity), the result for the universal-gravitation units of mass and force

* The last of a series of Lectures on the Practical Applications of Electricity, delivered on Thursday Evening, May 3rd, 1883, at the Institution of Civil Engineers.

is respectively 15.36 French tons, and 15.36 dynes, or 15.07 times the terrestrial surface weight of a kilogram.

The ultimate principles of scientific measurement were illustrated by the ideal case of a traveller through the universe who has brought with him on his tour, no weights, no measures, nor watch or chronometer, nor any standard vibrator or spring balance, but merely Everett's units and constants and a complete memory and understanding of its contents, and who desires to make for himself a metrical system agreeing with that which he left behind him on the earth. To recover his centimetre the readiest and most accurate way is to find how many wave lengths of sodium light there are in the distance from bar to bar of a grating which he can engrave for himself on a piece of glass. How easily this is done, supposing the grating once made, was illustrated by a rapid experiment performed in the course of the lecture, without other apparatus than a little piece of glass with 250 fine parallel lines engraved on it by a diamond, and two candles and a measuring tape of unknown divisions of length (only used to measure the *ratio* of the distance between the candles to the distance of the grating from either). The experiment showed the distance from centre to centre of consecutive bars of the grating to be 32 times the wave length of yellow light. This being remembered to be 5.89×10^{-5} of a centimetre, it was concluded that the breadth of the space on which the 250 lines are engraved is 250. 32. $5.892. 10^{-5}$, or 0.4726 of a centimetre. According to the instrument maker it is really 0.5 of a centimetre! Five minutes spent on the experiment instead of one, and sodium flames behind fine slits, instead of open candles blowing about in the air, might easily have given the result within one-half per cent instead of $4\frac{1}{2}$ per cent. Thus the cosmic traveller can easily recover his centimetre and metre measure. To recover his unit of time is less easy. One way is to go through Foucault's experimental determination of the velocity of light.

But, he must not be imagined as electrically-minded; and he will certainly, therefore, think of "*v*," the number of electrostatic units in the electro-magnetic unit of electricity; but he will probably see his way better to doing what he wants by making for himself a Siemens mercury unit (which he can do easily, now that he has his centimetre), and finding (by the British Association method, or Lorenz's with Lord Rayleigh's modification, or both), the velocity which measures its resistance in absolute measure. This velocity, as is known from Lord Rayleigh and Mrs. Sidgwick, is 9413 kilometres per mean solar record, and thus he finds, in mean solar seconds the period of the vibrator, or arbitrary-unit chronometer, which he used in his experiments.

Still, even though this method might be chosen as the readiest and most accurate, according to present knowledge of the fundamental data for recovering the mean solar second, the method by "*v*" is too interesting and too instructive in respect to elimination of properties of matter from our ultimate metrical foundations to be unconsidered. One very simple way of experimentally determining "*v*" is derivable from an important suggestion of Clark and Bright's paper, referred to above. Take a Leyden jar, or other condenser of moderate capacity (for example, in electrostatic measure, about 1000 centimetres), which must be accurately measure. Arrange a mechanism to charge it to an accurately measured potential of moderate amount (for example, in electrostatic measure, about 10 c.g.s., which is about 3000 volts), and discharge it through a galvanometer coil at frequent regular intervals (for example, ten times per second). This will give an intermittent current of known average strength (in the example, 10^8 electrostatic c.g.s., or about $1/300,000$ c.g.s. electro-magnetic, or $1/30,000$ of an ampere), which is to be measured in electro-magnetic measure by an ordinary galvanometer. The number found by dividing the electrostatic reckoning of the current, by the experimentally found electro-magnetic reckoning of the same, is "*v*," in centimetres per the arbitrary unit of

time, which the experimenter in search of the mean solar second has used in his electrostatic and electro-magnetic details. The unit of mass which he has chosen, also arbitrarily, disappears from the resulting ratio. It is to be hoped that before long "*v*" will be known within 1/10 per cent. At present it is only known that it does not *probably* differ 3 per cent from 2.9×10^{10} centimetres per mean solar second. When it is known with satisfactory accuracy, an experimenter, provided with a centimetre measure, may, anywhere in the universe, rate his experimental chronometer to mean solar seconds by the mere electrostatic and electro-magnetic operations described above, without any reference to the sun or other natural chronometer.

The remainder of the lecture was occupied with an explanation of the application of the absolute system in all branches of electric measurement, and the definition of the now well known practical units founded on it, called ohms, volts, farads, microfarads, amperes, coulombs, watts. The name mho, found by saying ohm to a phonograph and then turning the drum backwards, was suggested for a unit of conductivity, the reciprocal of resistance. The sub-division, millimho, will be exceedingly convenient for the designation of incandescent lamps.

The British Association unit has been found by Lord Rayleigh and Mrs. Sidgwick to be 0.9868 of the true ohm (10^9 centimetres per second), which differs by only 1/50 per cent from 0.9870, the number derived from Joule's electrothermal measurements described in the British Association Committee's report of 1867, with 772 Manchester foot-pounds taken as the dynamical equivalent of the thermal unit from the measurement described in his Royal Society's paper of 1849, and confirmed by his fresh measurement of twenty years later, published in his last Royal Society paper on the subject.

It is satisfactory that, whether for interpreting old results, or for making resistance-coils anew, electricians may now safely use the British Association unit as 0.9868, or the Siemens unit as 0.9413, of the ohm defined as 10^9 centimetres per second.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 17, 1883.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

THE following certificates were read for the first time:—T. H. Coleman, B. Hobbs, B. P. Lascelles, M. F. Purcell, W. R. Reffell, D. Wilson.

It was announced that a ballot for the election of Fellows would be held at the next meeting of the Society on June 7.

THE PRESIDENT then called on Capt. W. de W. ABNEY, F.R.S., to deliver a lecture "*On Photographic Action studied Spectroscopically.*"

The Lecturer said that he wished all chemists to become photographers, for photography occupied the border-land between chemistry and physics. The days had been long past when black fingers were a necessary concomitant of photography. At the present time there was a vast number of amateur photographers, but there were but few who studied the scientific aspect of photography. By most experimenters it was looked upon as a servant to be abused rather than used, and the majority were content with working by rule-of-thumb. The Lecturer was firmly impressed with the fact that photographic action is inter-atomic. He had already shown in a previous paper that throughout the absorption spectra of a series of organic compounds the absorption due to hy-

drogen could be recognised. Something of the same kind seems to occur in inorganic chemistry.

Probably the first photographic action with which most chemists become acquainted is the blackening of chloride of silver by light. Now if this salt be perfectly dry, and perfectly free from organic matter, &c., it will not blacken when exposed to light. Two tubes were exhibited, both of which had been exposed for some time to the action of light: in one the chloride was quite white; in the second the chloride, which was moist, had blackened.

The action of developers was then discussed. A picture on iodide of silver paper, which had been previously exposed, was developed before the meeting, with gallic acid and solution of silver nitrate. The action of the light is to liberate free iodine, and the developer precipitates metallic silver to form the image; the number of particles acted on by the light must be extremely small. The image can be washed off with nitric acid, and a fresh picture taken on the same film. A second image was developed with citrate and oxalate of iron; in this case the metallic silver must have been obtained from the film itself. Some other experiments were shown, proving the truth of this statement: Development is not a chemical but a physical action.

It was found on photographing the solar spectrum that the amounts of energy in different parts were very varied and irregularly distributed; recourse was had to the positive pole of the electric arc light. The incandescent light had not sufficient energy, but the positive pole furnishes a spectrum which has sufficient energy, and is much more uniform than the solar spectrum. For producing the spectrum everyone would probably first choose the diffraction grating, but it was found that a perfect grating did not exist, and one grating differed so much from another, owing to minute differences in the ruling, that eventually a glass prism was adopted, as the grating could not be relied on for quantitative work.

Films of chloride, bromide, and iodide of silver were successively interposed in the beam of the electric lamp, and it was shown that the chloride partially cut off the violet end of the spectrum, the iodide absorbed the whole of the violet, but the bromide cut off part of the blue as well as the violet. An image of the spectrum was then thrown on films containing respectively silver chloride, bromide, and iodide, and the plates were developed with ferrous oxalate. It was seen that with the chloride but a small portion of the spectrum had acted on the silver salt, and that with the bromide a very much longer image was obtained.

The action of sensitisers was next considered. The part played by a sensitiser is the taking up of the chlorine, bromine, and iodine set free by the action of light. To demonstrate this action, an image was thrown on to a sensitive plate, and during the exposure a streak was made across the plate with a solution of sodium sulphite. On developing, a black stripe indicated the position of the sodium sulphite, this salt having rendered the silver salt in its vicinity more sensitive. A sensitiser is useless unless it be close to the salt on which it is to act, so all sensitisers are more or less hygroscopic, or they may act in solution or as vapour. Almost any organic compound acts as a sensitiser.

The Lecturer then gave instances of coloured sensitisers, and photographs of the spectrum were taken on films coloured with cyanin-blue and with eosin. The plates were developed, and the relation between the portion of the spectrum photographed and the portion absorbed by these pigments demonstrated. Thus cyanin-blue absorbs the yellow, and the photograph of the spectrum on the film coloured with cyanin-blue exhibits a band in the yellow where the absorption had been previously seen. It is very remarkable that one salt of silver may act as a sensitiser to another salt of silver. Thus a film containing bromide of silver photographs much more of the spectrum than two films containing the one bromide and the other iodide.

It is easy to destroy the results of photographic action. If a film during exposure be washed with any oxidising agent, as potassium permanganate or bichromate, dilute nitric acid, peroxide of hydrogen, &c., the image is completely effaced. Thus, if plates which are foggy from accidental exposure be dipped in dilute bichromate of potash and well washed, they are restored to their original condition. This bleaching effect was demonstrated by throwing a picture on a sensitive plate, and during exposure making a streak with bichromate solution across the plate. On developing, this streak was seen to be white. A sensitive plate, after exposure to light, was soaked in dilute nitric acid, containing 1 drop of acid in 8 ozs. of water, and then exposed to the spectrum; the tendency of the nitric acid was to oxidise. At the violet end where the reducing power of the light was at its maximum this tendency was overcome, but the red end was perfectly white. A method of obtaining a reversed image was demonstrated. A sheet of iodised paper was exposed to light, then immersed in potassium bromide solution. A picture was then thrown on it; on developing, it was found to be reversed.

An instructive experiment was also shown of an easy means of preventing the bad results of over exposure. An extremely sensitive dry plate was soaked in sodium sulphite solution, and exposed for sixty seconds to a bright spectrum. On developing, a good picture came out, not in the least reversed. So a picture cannot be reversed if some substance is present in the film having a great affinity for oxygen.

A beam of light was transmitted through films of the three varieties of silver bromide. The ordinary variety was orange; the film used in the gelatin dry plates, a sort of French grey; the film used for photographing the ultra-red portion of the spectrum, green.

In conclusion the lecturer said he had endeavoured to point out to the chemists present, some of the pitfalls which beset the practice of photography.

The PRESIDENT, in proposing a hearty vote of thanks to Captain Abney, said that all must feel that they had had a great scientific treat. Most chemists had dabbled in photography, and must have felt how many points required investigation. He hoped that Capt. Abney would continue his researches, and he was sure that no one was more able to carry them out to a successful issue.

The vote of thanks was passed by the crowded meeting with acclamation, and the Society adjourned to June 7, when a ballot for the election of Fellows will be held, and the following paper read:—"Laboratory Notes," by Dr. Gladstone and Mr. Tribe: "1. On the Action of Light and Heat on Cane- and Invert-Sugar; 2. On Hydroxyl-amin; 3. Recovery of Iodine from Organic Iodide Residues; 4. A Residual Phenomenon of the Electrolysis of Oil of Vitriol; 5. On an Alleged Test for Alcohol; 6. Reaction of the Copper-zinc Couple on Nitric Oxide; 7. On the Reducing-action of Spongy Lead.

Separation of Copper and Zinc by Sulphuretted Hydrogen.—E. Berglund.—The author, after discussing the failure of various authorities in effecting this separation, gives the following direction, which he has found sufficient:—The mixed solution of metallic salts (sulphates or chlorides) are concentrated so as to contain about 5 m.grm. metal per c.c. The solution may be more dilute, but not more concentrated. To the liquid is then added 1.5th volume of hydrochloric acid of sp. gr. 1.10, and it is then precipitated with sulphuretted hydrogen in moderate excess. The precipitate of copper sulphide is immediately filtered off, washed first with dilute hydrochloric acid containing sulphuretted hydrogen (10 to 20 vols. sulphuretted hydrogen water to 1 vol. hydrochloric acid), and then with dilute sulphuretted hydrogen water (1 vol. saturated sulphuretted hydrogen water to from 100 to 120 vols. water. The confirmatory analyses are satisfactory.—*Zeitschrift für Analytische Chemie.*

NOTICES OF BOOKS.

Materia Medica: a Manual for Students. By ISAMBARD OWEN, M.D. London: J. and A. Churchill.

THE author, in his Preface, does not claim for his book the rank of an original or complete treatise on *Materia Medica*. He intends it rather as a supplement to than as a substitute for the systematic work, and seeks "to aid students by placing the outlines of the subject before them in such a manner that they may be clearly grasped and readily committed to memory." It is of course highly desirable that the student should "clearly grasp"—is there not here a slight confusion of metaphor?—the principles of his subject. But committing to memory savours somewhat of cram.

The work, however, possesses the valuable properties of clearness and brevity in an eminent degree. Some ingenuity would be required to find a superfluous word, and a still higher amount to misinterpret the descriptions and instructions given.

Under the carbo-hydrates we notice the statement that beet-sugar is precisely the same compound as cane-sugar, —a view which is becoming more and more questionable. Bees, at least, can perceive a difference.

Logwood is stated to be a native of the East and West Indies. We most strongly doubt the former locality, and in the latter it seems to have been introduced from Central America.

Otherwise, we see nothing in the book to which reasonable exception may be taken, and think that it is well adapted to the end in view.

OBITUARY.

THE LATE DR. JAMES YOUNG.

THE death of this distinguished industrial chemist has excited a regret by no means confined to scientific circles. Dr. James Young was born in Drygate, Glasgow, in 1811. His elementary education was received at a parochial school in the neighbourhood. We next find him assisting his father in his business as a carpenter. But an inbred scientific instinct led him to attend the evening lectures on chemistry delivered at the Andersonian Institution by Thomas Graham, F.R.S., afterwards Master of the Mint. His abilities and his enthusiasm for science attracted the notice of Professor Graham, who, in 1832, gave him the position of assistant in his laboratory, first in Glasgow and afterwards at University College, London. This position he filled with credit to himself and satisfaction to his employer until 1839. He was next appointed manager at the extensive alkali works of Messrs. Muspratt, at Newton in the Willows, Lancashire. His managership was, as we happen to know, eminently successful, not merely as regards the quantity and quality of the product, but in the difficult task of avoiding nuisance and injury to neighbouring estates. In 1843, his connection with the Muspratts terminated, and he occupied a similar position at the chemical works of Messrs. Tennant, at Manchester. Here he greatly extended his experience, and here he devised an original and elegant process for the manufacture of stannate of soda. Instead of taking metallic tin as his starting-point, he fluxed the ore with soda, thus saving a number of expensive manipulations. Whilst at Manchester he formed the acquaintance of Dr., now Sir Lyon Playfair, at that time Professor of Chemistry in the Royal Institution of that city. By him Young's attention was drawn to a spring of petroleum which had been discovered in Derbyshire. He at once undertook the utilisation of this new product, and obtained from it both an illuminating oil and a lubricant. When the oil-well ceased flowing, Young undertook the task of obtaining an

artificial petroleum by the regulated distillation of certain carboniferous shales. In this attempt he succeeded, the chief products of the process being the well-known paraffin oil, and the almost equally celebrated solid paraffin, or "paraffin wax." By these inventions the cost price of light in all places where gas is not available was greatly reduced. It was even found that for many purposes a well-trimmed paraffin lamp was superior to gas, as burning more steadily and giving off no sulphurous acid. Fortunately, whilst largely benefitting his country and the world at large, Mr. Young, unlike certain meritorious inventors, reaped a well merited reward for his skill and perseverance. The competition of the American native petroleum of course tended to reduce the value of paraffin oil. But if the oil wells of Pennsylvania, as many believe, have seen their most productive days, the distillation of oil shales has an immense future in prospect. We cannot help here noticing that certain attempts have been made to depreciate Young's merits by insinuating that the principles of his patented process were previously known. But if known they were dormant. Young alone gave them practical life and utility, and created a novel and a most important industry. In carrying out his operations at Bathgate, he was associated with Mr. Meldrum, formerly of Alfreton, and Mr. Binney, F.R.S., of Manchester, the eminent geologist. One of his earliest materials was the famous "Torbanehill mineral," which involved him in a tedious and complicated lawsuit. He had acquired a lease of coal underlying certain lands, and under that lease was working the mineral in question. The lessors of the land contended that the Torbanehill mineral was not coal, and brought an action to restrain him from working it. Almost all the foremost chemists and geologists of the day were called to decide the question, and contradicted each other in an unedifying manner. The case was ultimately compromised as incapable of decision. But the general opinion now is that scientific evidence was here out of place. The mineral at issue was capable of subserving the uses to which coal is commonly put, and might, therefore, justly be regarded as coal from a business point of view. Mr. Young erected another and larger manufacturing establishment at Addiewell, and continued the business at both until it was ultimately turned over to the large limited liability company by which it is still conducted. Mr. Young has been no less distinguished for his public spirit and munificence than for his eminence as a technical chemist. He founded some years ago at the Anderson Institute, now known as the Anderson College, a Chair of Industrial Chemistry, and endowed it with fifteen thousand guineas. He caused a bronze statue to be cast of his early friend and patron, Thomas Graham, and presented it to his native city, where it now forms one of the chief ornaments of St. George's Square. At his own expense and in collaboration with Dr. Angus Smith, Mr. Young collected together into one large handsomely-printed volume of over 650 pages all Graham's memoirs, and presented copies to the friends of Graham and to chemists in various parts of the world.

When working in Graham's laboratory, he formed the acquaintance of David Livingstone, who was then employed during the day at a cotton mill. The friendship which sprung up between them was terminated only by death. Young had even sent out an expedition to relieve and rescue the great African traveller, but the news of his death caused its return without having accomplished anything.

It will not, we hope, be considered impertinent if we suggest that some public honour should be done to the memory of a man who has deserved so well of Science, of his country, and of the world.

The Transmission of Sound by Gases.—M. Neyreneuf.—The author finds that the law of Hawksbee is not exact.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 18, April 30, 1883.

Pyro-electricity of Quartz.—C. Friedel and J. Curie.—A critique of the results of M. Hankel.

A Quaternary Base derived from Oxy-quinoleine.—A. Wurtz.—The author finds that oxy-quinoleine may unite with ethylene hydrochlorate to form an oxy-ethyl-oxy-quinoleine, $C_{11}H_{12}NClO_2$.

Use of a Doubly-Refractive Glass in certain Operations of Spectral Analysis.—M. Cruls.—The use of a doubly-refractive crystal in certain researches of spectral analysis seems to the author to offer decided advantages. He hopes shortly to describe an apparatus which he names the polarispectroscope.

Analogy between the Allotropic States of Phosphorus and of Arsenic.—R. Engel.—The author has previously shown that whenever arsenic is liberated from one of its compounds at a temperature below 300° , it is obtained in an allotropic state. According to the textbooks arsenic sublimes at 180° ; this is inaccurate. Crystalline arsenic kept for some hours in an inert gas at a temperature bordering upon 360° , or for eight hours in a vacuum, does not sublime. Crystalline arsenic, therefore, is not volatile below 360° . Amorphous arsenic begins to sublime in a vacuum at 260° , and in an inert gas at 280° to 310° . The sublimation is rapid, but it stops after some hours. The residue is no longer capable of sublimation, even at 360° ; its density has become 5.7; in a word, the amorphous arsenic has been transformed. This difference between the temperatures at which the two states of arsenic sublime is very well marked. Amorphous arsenic is transformed below 360° (about 310°) if the action of the heat is sufficiently prolonged. Amorphous arsenic resembles white phosphorus, whilst crystalline arsenic resembles red phosphorus. Red phosphorus crystallises, and its crystals are isomorphous with those of arsenic. The density of red phosphorus is higher than that of white phosphorus, just as that of crystalline arsenic is higher than that of the amorphous kind. White phosphorus, like amorphous arsenic, sublimes at a temperature lower than that at which it is transformed. Red phosphorus, like crystalline arsenic, is not sublimable at this temperature. The vapour given off by red phosphorus yields white phosphorus when cooled below the temperature at which transformation takes place, just as the vapour of crystalline arsenic gives amorphous arsenic below 300° .

A Process for Hardening Soft Calcareous Stones by Means of Silico-fluorides having a Base of Insoluble Oxides.—L. Kessler.—The author criticises the use of alkaline silicates for hardening building stones, and recommends, in preference, magnesium, aluminium, zinc, or lead silico-fluorides, which, if applied in a few layers, produce great hardening, whilst no soluble compound is formed by the reaction.

Researches on the Metallic Derivatives of the Amides. Means of Distinguishing a Mono-amide from a Di-amide.—H. Gal.—In a former paper the author has shown that by the reciprocal action of zinc-ethyl and of a non-saturated amine, there is liberated ethyl-hydride, whilst the zinc takes the place of the hydrogen in the amine employed. With the amides similar results are obtained. The author has studied the action of zinc-ethyl upon the amides of the fatty series; those of the aromatic series and upon the di-amides. The action of zinc-ethyl upon the amides is very different,

according as a mono-amide or a di-amide is present. In the former case two molecules of the compound intervene, but only one in the second. Hence by causing zinc-ethyl to react upon substances of imperfectly known constitution, but which may be connected with the amides, we may, from the results obtained, determine the class to which they belong.

A Means of Foreseeing the Escape of Fire-damp.—B. de Chancoutois.—The author recommends that continuous observations should be made in coal-mines with the seismograph.

No. 19, May 7, 1883.

Very Sensitive Reactions of the Salts of Iridium.—Lecoq de Boisbaudran.—This paper will be inserted in full.

Specific Heats of Certain Gases at Elevated Temperatures.—M. Vieille. The mean specific heat of the gases,—carbon monoxide, nitrogen, hydrogen, and oxygen—for constant volumes, varies by, at most, two-thirds of its value between 0° and 4400° .

The Electric Dynamograph or Apparatus for Registering the Work of Machines.—C. Resio.—The author has devised an apparatus which registers automatically, a curve of which the ordinates are proportional to the effort applied to the motor axle, and the abscissæ proportional to its angular velocity. Consequently, the area comprised between any two ordinates, the curve, and the axis of the abscissæ, shows the work of the machine in the time in which the diagram has been traced.

A Fundamental Point of Theory of the Report presented by M. Cornu.—G. Cabanellas.—A mathematical paper, not capable of useful abstraction.

Archives Néerlandaises des Sciences Exactes et Naturelles, Tome xvii., Part 4.

Thermo-chemical Researches on Ozone.—E. Mulder and H. G. L. van der Meulen.—Admitting that the combination-heat of one affinity of an atom of oxygen with an affinity of another atom of oxygen is always the same, both in ordinary oxygen and in ozone, we are led to the formula $O-O-O$ for ozone, because in $3(O=O)$ and $2\left(\begin{smallmatrix} O-O \\ \diagdown \quad \diagup \\ O \end{smallmatrix}\right)$ there are twelve affinities which neutralise

each other two and two. Consequently, in the transformation of ordinary oxygen into ozone there can be absorption of heat, whilst experience proves the contrary. The authors consider that the structure $O-O-O$ is rendered probable by the slight stability of ozone;

$\begin{smallmatrix} O \\ \diagup \quad \diagdown \\ O-O \end{smallmatrix}$ would indicate greater stability. The fact that

neither heat nor light, but merely electricity, can transform ordinary oxygen into ozone is explained, because the gaseous molecules charged with different electricities may arrive temporarily at a state of rest, which is favourable to the attraction of the molecules and the atoms. Not only there have been speculations put forward—especially of late—on the manner in which the elements may be constructed, but attempts have been made to penetrate experimentally to their structure. But it is known that we cannot for the present indicate a single fact which obliges us to admit that an element, and in like manner an atom, may be disintegrated by the means which science at present possesses. It is even little probable that electricity at its maximum tension could dissect an atom. As far as the authors are aware the following hypothesis has not yet been announced, though its value is naturally very relative:—It is that the so-called atom may be regarded as the atom of the first order, con-

structed of atoms of the second order, which are in turn composed of atoms of the third order, and so on to infinity. This hypothesis does not exclude the unity of matter. According to this view the atom is infinitely complex, and every attempt to obtain a complete knowledge of matter clashes with the impossibility of making an infinite series of experiments.

Researches concerning Electro-magnetic Dispersion on a Spectrum of Great Extent.—W. C. L. van Schalk.—Not suitable for useful abstraction.

Tome xviii., Part 1.

Electro-magnetic Rotation of the Plane of Polarisation.—W. C. L. van Schalk.—This important memoir requires the accompanying illustrations, and is otherwise incapable of useful abstraction.

Zeitschrift für Analytische Chemie.
Vol. xxii., Part 2, 1883.

A New Method for the Volumetric Determination of Phosphoric Acid in Superphosphates.—A. Mollenda.—Inserted in full.

Contributions to the Analysis of Wine (Continuation).—Dr. J. Nessler and Dr. M. Barth.—In this section the authors discuss the determination of the free tartaric acid. They adopt the following modification of the process of Berthelot and Fleuriot:—Two portions of the sample, each of 20 c.c., are taken; to the one are added 4 drops (0.15 to 0.2 c.c.) of a 20 per cent solution of slightly acid potassium acetate, and each is then mixed with 100 c.c. of alcohol-ether, well shaken, and allowed to stand in a stoppered flask for at least eighteen hours in a place not warmer than 10°. The precipitate, after filtration, is dissolved in a small quantity of water at a gentle heat, and the solution is titrated with vigintinormal alkali. In strongly plastered wines the accurate determination of free tartaric acid has not been effected. The authors treat further of the determination of sugar, gum arabic, fixed and volatile acidity, of tannin in white wines, and of glycerin in sweet wines.

Determination of Total Sulphur in Coal-gas.—Theodor Poleck.—This paper cannot be usefully reproduced without the accompanying illustration showing the apparatus.

A New Method for Determining Sulphur in Organic Bodies.—Peter Claesson.—This memoir will be inserted in full.

The Quantitative Determination of Traces of Silver.—C. F. Föhr.—This paper will be inserted in full.

Determination of Nicotine in Tobacco.—R. Kissling.—The author refers to a previous memoir on this subject, defends his method against the renewed criticisms of Skälweit, examines the modifications proposed by the latter, and replies to Prof. Dragendorff.

Comparative Determinations of Sugar according to the Methods of Fehling and of Sachse, and to the Polarimetric Principle.—Dr. B. Haas.—The author concludes that in ordinary impure glucose the polarisation process constantly gives too high a percentage of sugar, the error being sometimes very considerable. Though in many cases concordant results can be obtained by the methods of Fehling and of Sachse, this does not always occur, and the discrepancies are often important. For determining sugar, both in impure glucose and in wine, Fehling's solution is unquestionably preferable to that of Sachse.

Determination of Chlorine in Liquids containing dissolved or suspended Organic Matter, and possibly Sulphur Compounds.—Dr. F. Muck.—The liquid is evaporated nearly or quite to dryness, the residue moistened with a sufficiency of caustic soda or potassa,

free from chlorine, heated, and solution of permanganate is added until the green colouration is permanent. Alcohol is then added drop by drop till the green colour disappears; alcohol and aldehyd are driven off, the liquid is filtered, and the residue is washed with hot water.

Copper Hydroxide.—Dr. Julius Loewe.—The author contends for the stability of his preparation, in answer to Soxhlet.

The Detection and Determination of Lactic Acid.—R. Palm.—If a solution of basic lead acetate is mixed with an excess of ammoniacal alcohol (Dzondi's liquor), 1 part to 5 or 6, and if aqueous lactic acid is added, the more concentrated the better, there is formed a white amorphous precipitate, the lactic acid being entirely deposited as lead lactate. The most convenient way of operating is to add ammoniacal alcohol to a mixture of basic lead acetate and lactic acid so long as a precipitate is formed. Lead lactate is soluble in excess of water, in acetic and lactic acids, and in caustic alkali. In quantitative determinations the precipitate is therefore washed with alcohol. One grm. lead lactate, dried at 100°, contains 0.788 lead oxide.

Certain Reagents for Vegetable Alkaloids.—R. Palm.—This paper will be inserted at length.

Detection of Free Sulphuric Acid in Presence of Organic Acids.—W. Bachmeyer.—The author prepares a red test-paper by dipping pure filter-paper, free from acids, into moderately strong extract of sapan-wood, and lets it dry. This paper keeps good for months if light is excluded. Slips of this paper are plunged for about half a minute into the liquid under examination, and allowed to dry slowly in the air. If sulphuric acid is present in quantity, not less than 1 part by volume in 500, the entire slip, or its edges, when perfectly dry, takes a fine peach-blossom colour. A comparative experiment with a similar liquid free from sulphuric acid removes all doubt. As in most cases a gradual concentration of the liquid on the water-bath to one-fifth of its original bulk is permissible, 0.04 per cent by measure of sulphuric acid can be thus detected. The reaction is especially useful in the examination of wine and vinegar. It must be remembered that free nitric and hydrochloric acids produce the same results as sulphuric acid.

Tap for Store-bottles of Distilled Water, Aspirators, &c.—Josef Sobieczky.—The author's arrangement cannot be understood without the accompanying cut.

Determination of Phosphoric Acid and Magnesia.—R. Ulbricht.—The author lays prior claim to the method described by Dr. Broockman in the *Zeitschrift* for 1882, p. 551.

Albuminoid Bodies in Milk.—Leo Liebermann.—The author points out that he has anticipated the results published by Dr. E. Pfeiffer on p. 14 of the present volume (see *Liebig's Annalen*, 181, p. 90).

A Procedure for Qualitative Analysis by means of the Microscope.—H. Reinsch.—The author prepares a dilute solution—about 4 per cent—of the substance in question, allows a drop to evaporate on a slip of glass, and examines the residue under the microscope, fitted with a polarising apparatus. A previous acquaintance with the appearance of the substances sought for, and an acquaintance with microscopic work are necessary.

Spectroscopic Anomalies.—L. Palmieri.—When mixed chlorides are introduced into the flame, the spectral lines of one alone are apt to appear. The spectrum of copper chloride is not visible, except in large excess, in presence of sodium chloride. In a mixture of iron, sodium, lithium, and potassium chlorides, the spectra of the three latter only are visible.

A Source of Error in Polarisation.—A. Hölzer.—Coloured liquids give discrepant rotations, both by daylight and lamp-light. The influence of colour is insignificant if the monochromatic soda-light is used.

An Automatic Gas Closer.—H. Michaelis.—An apparatus for turning off a current of gas at any required time. The principle is that of an alarm clock.

Improvement in Water-drying Ovens heated by Gas.—E. Seelig.—The arrangement cannot be described without reference to the diagram.

A Modification of Erdman's Float.—A. Gawalowski.—Instead of a line engraved on the outside of the float the author fixes a slip of black paper horizontally in the inside. The upper edge of the paper can be seen more sharply than an engraved line.

Absorption of Hydrogen by Palladium.—H. Tschirikoff.—The author utilises this reaction for absorbing hydrogen given off in operations conducted in sealed tubes.

Filter-paper washed with Hydrochloric and Hydrofluoric Acid.—This process was recommended some time ago by P. Townsend Austen, and is now carried out on the large scale by Schleicher and Schull. The tenacity and closeness of the paper are not injured, and the proportion of mineral matter is reduced so low that it may be neglected even in accurate analyses.

The Volumetric Determination of Alumina.—A. von Reiss.—The solution is mixed with ammonia to neutralise free acid, slightly acidified with acetic acid raised to a boil, and there is added some calcium chloride. If the solution contains sulphuric acid the calcium chloride must be added in such quantity that no precipitate of calcium sulphate is produced. A standard solution of ammonium oxalate is then gradually added, keeping the liquid at a boil, and observing when a distinct turbidity appears, which marks the end of the reaction. Three equivalents ammonium oxalate consumed indicate one equivalent alumina.

Determination of Chromium as Chromic Oxide.—A. Souchay has shown that if chromium hydroxide is precipitated with ammonia in glass vessels, the results are always too high. Th. Willm confirms the statements of Souchay. In precipitating with ammonia or ammonium sulphide, he obtained errors in excess up to 6 per cent. These differences depend entirely on the use of glass vessels.

Volumetric Determination of Zinc with Potassium Ferrocyanide.—According to M. Galletti, before titrating zinc with ferrocyanide, manganese must be removed. C. Fahlberg, on the other hand, maintains that manganese has no disturbing influence. R. W. Mahon has re-examined the question, and finds that, contrary to the statements of Fahlberg, zinc and manganese are both precipitated by ferrocyanide, and that an increased addition of acid is not able to prevent the precipitation of manganese. If zinc has to be titrated with ferrocyanide in manganiferous zinc ores, Mahon recommends that the ammoniacal liquid remaining after removal of the metals of the 5th and 6th groups and of iron, should be distinctly acidified with acetic acid, precipitated with sulphuretted hydrogen to separate zinc from manganese. The precipitate of zinc sulphide is then well washed, dissolved in hydrochloric acid, and the solution used for titration.

Determination of Cobalt and Nickel.—E. Fleischer.—Already inserted from the *Journal für Praktische Chemie*. E. Donath proposes the following modification:—The solution containing the two metals is halved. In the one half both metals are precipitated by boiling with potassa or bromine, whilst in the other half the cobalt alone is thrown down as a sesquioxide by boiling with potassa and iodine; a saturated solution of iodine in potassium iodide. The determination of the sesquioxide in each of the two precipitates is effected iodometrically by boiling the precipitates in a suitable apparatus with hydrochloric acid, receiving the chlorine evolved in solution of potassium iodide, and titrating the liberated iodine with decinormal sodium hyposulphite. As 1 equiv. iodine represents 2 equivs. of cobalt or nickel (the atomic weights of each

being equal), the difference of the c.c. of decinormal hyposulphite consumed in the two titrations, multiplied by 0.0059, gives the weight of the nickel, and the number of c.c. used in the second operation, likewise multiplied by 0.0059, shows the weight of the cobalt.

Volumetric Determination of Lead, Zinc, Copper, and Mercury.—C. A. M. Balling.—The author submits the sulphides of these metals to prolonged ebullition with a solution of silver nitrate and sodium acetate. In case of the sulphides of the three former metals, a measured quantity of a silver solution of a known strength is employed, and in the filtrate the excess of silver nitrate is titrated with potassium sulphocyanide. The difference between the quantity of silver originally employed and that remaining in the filtrate is equivalent to the metal in question. In case of mercury sulphide the silver sulphide formed is filtered off, well washed, dissolved in nitric acid, and the quantity of silver is determined volumetrically with potassium sulphocyanide.

Volumetric Determination of Copper and Lead.—The method of Pelouze is open to the objection that the end of the reaction is not easily recognised. F. Mohr and C. Künzel (*Journal Prakt. Chemie*) have already sought to overcome this difficulty. Paul Casamajor proposes the following modification:—He mixes the solution of copper in a porcelain vessel with an excess of alkaline solution of potassium-sodium tartrate (prepared by dissolving 173 grms. of the double tartrate in 480 c.c. soda-lye, of sp. gr. 1.14, and making up to 1 litre), heats almost to a boil, and adds sodium sulphide until a drop no longer occasions turbidity. If the solution is well stirred it collects at the bottom of the vessel so completely that the supernatant liquid appears clear, and the slight turbidity occasioned by the last drop is distinctly visible.

Determination of Copper as Copper Oxide.—To obtain copper as a finely granular precipitate, easy to wash, W. Gibbs recommends to mix the dilute solution, containing not more than 1 gramme copper per litre, with alkaline carbonate in a slight excess, and to boil for half an hour to ensure complete precipitation. To avoid the prolonged boiling and the "bumping" of the liquid, F. P. Dunnington gradually adds a slight excess of sodium carbonate to the boiling dilute solution of copper, and then a dilute solution of caustic soda till the precipitate blackens. The precipitate subsides quickly, and can be completely washed by five or six decantations with hot water.

Detection of Sulphurous Acid.—B. Reinitzer.—The author points out that Bödeker's process for detecting sulphites along with hyposulphites by means of sodium nitro-prusside is wrongly described in the text-books. They direct the liquid to be acidified with acetic acid, whilst Bödeker expressly states that the reaction is sensitive only in neutral solutions, or such as contain sodium bicarbonate.

Indirect Determination of Chlorine and Bromine.—L. P. Kinnicutt.—Instead of converting the mixture of silver chloride and bromide entirely into silver chloride by heating in a current of chlorine, or reducing it in a current of hydrogen, the author effects the reduction galvanically.

Detection of Fusel Oil in Alcohol.—Jorissen recently proposed to mix the alcohol with colourless aniline oil and a little hydrochloric acid, when the presence of fusel oil is shown by a splendid red colouration. K. Förster shows that this reaction is due not to amylic alcohol, but to the furfural always present in crude fusel oil. This fact, however, does not affect the practical value of the test.

Alkaloids of the Cinchona Barks.—In addition to the analytical researches recently given in the *Zeitschrift*, the editors refer briefly to a number of investigations of newly-discovered alkaloids, and on properties of the alkaloids already known not directly applicable in analysis.

A Reaction of Morphine.—E. Grimaux.—From the *Comptes Rendus*.

Reactions of Quinoline.—Julius Donath and H. Hager describe the behaviour of the salts of this base with reagents. Their results do not always agree.

Behaviour of Saccharine with Silver Oxide.—H. Killiani.—On heating saccharine with silver oxide and water, carbonic acid is evolved, and there are formed formic, glycolic, and acetic acids. If dextrose and levulose are similarly treated there is formed oxalic acid in place of acetic.

Determination of Bromine in Organic Substances.—H. Schwarz.—The author proposes the following modification of Brügelmann's process:—The substance is weighed in a porcelain boat. The tube is filled as follows, beginning at the end where the oxygen enters:—A layer of platinised asbestos, the boat with the substance, an empty space, a layer of platinised asbestos 15 c.m. in length, a long and a short boat with pure sodium carbonate. To the other end is attached a Varrentrapp-Will bulb-tube filled with water. The ignition is so heated that the platinised asbestos remains white. The absorption boats containing sodium carbonate must be heated only moderately so that no sodium bromide may be volatilised. The author prefers, however, Volhard's titration process as more certain. (See *Zeitschrift*, xvii., p. 482, and xviii., p. 271).

Analysis of Organic Platinum Double Chlorides.—O. Wallach.—The salt to be analysed is weighed in a platinum capsule, covered with a fresh prepared solution of $\frac{1}{2}$ to 1 gramme soda in absolute alcohol: the excess of alcohol is expelled by gently heating upon the water-bath until a crystalline scum appears; the capsule is then set upon a triangle, and the alcohol is set on fire by means of the gas-flame. The platinum salt is decomposed, forming metallic platinum and sodium chloride, whilst the organic matter is consumed. When the flame of the alcohol goes out the capsule is heated for some time with a lamp. When cold the contents are treated with water and nitric acid, filtered, and the chlorine in the filtrate is determined with silver nitrate. The filter with its contents are returned to the capsule, and ignited till the filter and the carbon of the organic matter are consumed. The residue is then weighed for the determination of the platinum.

Determination of Phenol.—The method of E. Waller is taken from the *CHEMICAL NEWS*, and that of Chandelon from the *Bull. de la Soc. Chim. de Paris*.

The Proportion of the Reductive Powers of Tannin and Oxalic Acid with Solution of Permanganate.—C. Counciler and J. Schroeder.—If the reductive power of oxalic acid is 63, that of tannin = 34.2 or 34.3. Neubauer, in earlier experiments, obtained the proportion 63 : 41.57.

Separation and Determination of Picrotoxine.—R. Palm.—Picrotoxine is completely thrown down from its ammoniacal solutions by basic lead acetate, and may be obtained in a state of purity by treating the precipitate with hydrogen sulphide, filtering off the lead sulphide, and evaporating the filtrate. If fatty acids are present they are precipitated from the ammoniacal solution by means of baryta before throwing down the picrotoxine with basic lead acetate.

Examination of Air.—J. Reiset, A. Muntz, and E. Aubin.—No particulars are given.

Water Analysis.—J. W. Mallet.—A criticism on the methods in common use. The combustion method of Frankland and Armstrong gives results which cannot be regarded as an accurate determination of the organic carbon and nitrogen present in water. The carbon is always, and often considerably, too low, and the organic nitrogen frequently too high. Nevertheless, the method gives the organic carbon more accurately than the permanganate process, and the organic nitrogen more accurately than that of Wanklyn. This method gives both the free and the albumenoid ammonia too low, sometimes notably so, and the distinction between these two forms

of nitrogen is not always distinctly marked. The results of the permanganate process (Tidy's form) gives results which vary irregularly from those obtained in boiling liquids according to Kubel's form. In no case is the quantity of permanganate consumed which would be required for the complete oxidation of the organic matter.

On the Composition of Secondary Wines (Wines obtained by allowing a solution of sugar to ferment upon the grapes after pressing).—A Girard.—From the *Moniteur Scientifique* (series 3, xii., p. 895).

Detection of Starch in Sausages.—C. Amthor.—The author dissolves out fatty matter with ether and converts the starch into glucose by treatment with diastase.

Examination of Chocolate.—E. Herbst.—The author determines moisture, fatty matter, sugar, and ash. A small addition of oil of sesame, which is said to be common, cannot be recognised with certainty. Organic adulterations are sought for with the microscope.

Determination of Neutral Fats in Mixtures of Fatty Acids.—Max Gröger.—From 4 to 8 grms. of the sample are placed in a flask holding 300 c.c. and dissolved by heating to a gentle boil in 50 c.c. alcohol at '96° Tralles. A few drops of phenol phthaleine are added, and the liquid is mixed with semi-normal alcoholic solution of potassa till the red colour no longer disappears on shaking. It is then diluted with 150 c.c. water, shaken well up when cold with 60.100 c.c. ether, allowed to settle, and the clear solution of soap underlying the ethereal stratum is drawn off as completely as possible, but so that nothing of the ethereal liquid is taken away. It is largely diluted with water, and boiled till the alcohol and ether are expelled. The fatty acids are then liberated by the addition of dilute sulphuric acid, washed with hot water till the washings have no longer an acid reaction, let cool, and the equivalent weight of the carefully dried fatty acids are determined by titrating a weighed quantity with semi-normal alcoholic potassa.

Determination of Oil of Mustard in Rape Cake.—G. Ulex.—The author macerates the sample with lukewarm water for half an hour, distils until the distillate no longer smells of mustard; shakes it up with bromine (free from sulphuric acid), expels excess of bromine by heat, decolorises the liquid with ammonia, acidifies with hydrochloric acid, filters, and precipitates with barium chloride; 233 parts barium sulphate represent parts oil of mustard.

MEETINGS FOR THE WEEK.

- MONDAY, 28th.—Society of Arts, 8. Cantor Lectures. "Secondary Batteries and the Electrical Storage of Power," by Prof. Oliver J. Lodge, M.A., F.R.S.
- TUESDAY, 29th.—Institution of Civil Engineers, 8.
- Society of Arts, 8. "Queensland: its Progress and Resources," by Arthur J. Stanesby.
- Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
- WEDNESDAY, 30th.—Society of Arts, 8. "The Relative Claims of Etching and Engraving to rank as Fine Arts," by F. Seymour Haden, F.R.C.S.
- THURSDAY, 31st.—Royal Institution, 3. "Recent Discoveries in Chaldaea and Assyria," by Mr. R. S. Poole.
- Royal, 4.30.
- Society of Arts, 3. Prevention of Fires. (Public Meeting.)
- Royal Society Club, 6.30.
- Chemical, 8. Ballot for the election of Fellows. "Laboratory Notes:—On the Action of Light and Heat on Cane and 'Invert' Sugars; On Hydroxylamine; Recovery of Iodine from Organic Iodide Residues; A Residual Phenomenon of the Electrolysis of Oil of Vitriol; on an Alleged Test for Alcohol; Reaction of the Copper-Zinc Couple on Nitric Oxide; On the Reducing Action of Spongy Lead;" by Dr. J. H. Gladstone and Alfred Tribe.
- FRIDAY, June 1st.—Royal Institution, 8. "The Sword," by Prof. F. Pollock, 9.
- SATURDAY, 2nd.—Royal Institution, 3. "Russian Social Life," by Prof. Turner.

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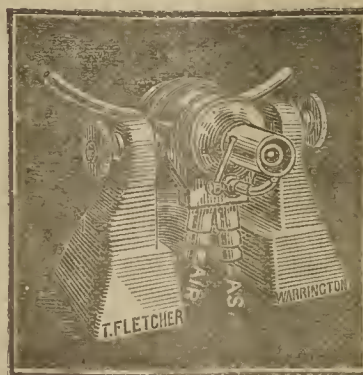
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NOTE ON THE ATOMIC WEIGHT OF BERYLLIUM.*

By J. EMERSON REYNOLDS, M.D., F.R.S.

IN the course of a paper by Professor Humpidge on the above subject, recently read before the Society,† the author seeks to decide between the atomic weight 9.2 for beryllium, resulting from my comparison of the atomic heat of the element with that of silver and aluminium,‡ and the value 13.8, arrived at by MM. Nilson and Pettersson by determination of specific heat||. The difference between the two possible atomic weights is so small, and the difficulties met with in attempting to prepare even a few decigrams of beryllium are so great that both sets of experiments have been objected to on the ground, amongst others, that the metal employed was in all cases impure. My specimen admittedly contained a minute quantity of platinum, and the proportion of known impurity in one of MM. Nilson and Pettersson's specimens reached 13 per cent. Unfortunately, Professor Humpidge's metal, though claimed to be the purest yet prepared, is shown by analysis to be rather less pure than one of the specimens employed by Nilson and Pettersson; hence the experiments lately made known to the Society do not carry the inquiry beyond the point previously reached, save in one noteworthy particular, namely, that there appears to be a considerable, though irregular, rise in specific heat of the element as the proportion of impurity diminishes; though the value is still much below that required for the atomic weight 9.2. Thus, for a specimen of beryllium which contained 13 per cent of known impurity, Nilson and Pettersson obtained the specific heat 0.4084 between 0° and 100° C., and for a less impure specimen 0.425; while Professor Humpidge, in one of his experiments, with a material that contained 6 per cent of impurity, found the specific heat to be nearly 0.45 (0.4497). In all these cases corrections were applied which were believed to eliminate the effects due to the impurities known to be present—in part mechanically mixed with the metal and partly alloyed with it.

These results all tend in one direction, that is to say, to apparent gain in specific heat with increased purity of material, and in so far they approach the still higher value obtained in my old experiments. But even if the latter had not been made, the apparent rise in specific heat shown by the other experiments would suggest the necessity for appeal to data afforded by beryllium of undoubted purity. In order that further experiments should now be considered decisive, the metal should not only be pure, but in the form of a homogeneous mass obtained by fusion, as the specimen I used was an apparently uncrystalline product of fusion, while the metal employed by Nilson and Pettersson chiefly consisted of "aggregations of little prismatic needles," mixed with the oxide.

The most promising source of pure beryllium is the double fluoride of the element and potassium, but I have not hitherto succeeded in making the product by reduction from a button of metal.

Professor Hartley has very recently made known some highly interesting, spectroscopic evidence§ affecting the

position of beryllium amongst the metals, and so directly bearing on the question of its valence that I may be permitted to refer to the results in this place.

If the atomic weight of beryllium be 13.8, the element is a triad and the formula of its oxide must be Be_2O_3 . It therefore resembles alumina in being a sesquioxide, but is at once distinguished as it does not form an alum-like double sulphate, as do alumina and its homologues, and has comparatively little in common with that group, save the tendency to form highly basic salts. Nilson and Pettersson,* admitting this, maintain that beryllium is a leading member of another group of triads, which includes the rare earth-metals scandium, yttrium, lanthanum, didymium, terbium, erbium, &c. The recent spectroscopic evidence above referred to is opposed to this contention, as the spectrum of beryllium is stated to be wholly unlike the spectra afforded by the rare earth-metals with which it is classed in the memoir above cited. If, then, beryllium does not find a place in the two known families of metallic triads, it must stand alone; and in any case as a triad it is outside Mendeleef's classification. But if the atomic weight of beryllium be 9.2, according to my result, the metal is a diad, and the symbol for its oxide is BeO . It is, therefore, the first member of Mendeleef's second series of elements. This position is quite in accordance with the spectroscopic evidence obtained by Professor Hartley, from which it appears that "beryllium is the first member of a diad series of elements, of which in all probability calcium, strontium, and barium are homologues."

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.†

THIRD PAPER.

By Professor H. CARRINGTON BOLTON,
Of Trinity College, Hartford, Conn.

37. In the two papers previously published under the same title‡ we have shown that citric acid has a power of decomposing minerals little less than that possessed by hydrochloric acid, and that the organic acid can be advantageously employed in field-work for assistance in determining species. In the second of these papers we stated that the results obtained by the *prolonged* action of citric acid on minerals differed greatly from those recorded in the accompanying tables, and gave notice of our intention to return to the subject at a subsequent period. We have continued our researches, and gained a few additional facts which we deem of sufficient interest to warrant a third or supplementary paper on the subject.

The results given in the tables|| were obtained by acting on the minerals in fine powder; first, in the cold for a few hours, and secondly, at a boiling heat for a few minutes. We find, however, that many species which resist the brief action of a boiling concentrated solution of citric acid are more or less completely decomposed by prolonged contact with the same solution at the ordinary temperature of the work-room, say 60° to 70° F. But a small number of the two hundred minerals embraced in the tables were submitted to the prolonged action of the acid solution, and those tested were selected as representative of groups, sulphides, oxides, silicates, &c. The progress of decomposition was noted at various periods from a few days to more than two years. A solution of citric acid concentrated in the cold was used in all the experiments.

38. *Sulphides*.—Chalcocite showed signs of decomposi-

* A Paper read before the Royal Society, May 24, 1883.

† Read April 12, 1883.

‡ CHEMICAL NEWS, vol. xxxv., p. 124, and vol. xlii., p. 273. A slight modification of this method by comparison adopted is described in detail in this writer's "Experimental Chemistry" (Longmans), Part I, p. 59.

§ *Proc. Roy. Soc.*, vol. 31, p. 37.

¶ In a communication read before the Chemical Society, April 19, 1883.

* *Proc. Roy. Soc.*, vol. 31, p. 50.

† Read before the American Association for the Advancement of Science, Montreal Meeting, August, 1882.

‡ CHEMICAL NEWS, vol. xxxvi., pp. 249 *et seq.*; also vol. xliii., pp. 31 *et seq.*

|| *Ibid.*, p. 40.

tion at the end of ten days, and at the expiration of several months yielded a partial solution of a pure green colour.

Ullmannite showed signs of decomposing in two days, and afforded in a month a very dark-coloured solution.

Arsenopyrite was attacked in a few days. Pyrite showed decided evidence of decomposition in eight days; one month later the solution acquired a reddish yellow colour, and reacted for iron and sulphuric acid.

Chalcopyrite acts similarly, the solution being of a greenish yellow hue, and reacting for copper and sulphuric acid. One gramme of the mineral lost about 11 per cent of its weight after fourteen months' contact with the acid solution. In general quantitative experiments were not conducted, for it soon became clear that the amount of decomposition was proportionate to the time, and would require more attention than the results to be gained warranted.

Smaltite was decidedly attacked after eight days; the presence of sulphuric acid in the coloured solution was noted. Tetrahedrite was strongly attacked in about four months. Cinnabar, orpiment, argentite, and pyrrargyrite resisted the acid solution altogether.

39. *Oxides*.—The experiments recorded in this brief supplement were made with only those minerals which resisted the acid solution on boiling; and since it was obviously useless to test such bodies as quartz, corundum, rutile, &c., only the three oxides of iron remained of this class for examination.

Magnetite and limonite were strongly attacked in eight days; hematite yielded much more slowly, showing decided decomposition after several months.

Exposure to sunlight, as might be expected, diminished the intensity of the coloured iron solutions.

40. *Silicates*.—Of the silicates examined datolite is by far the most quickly decomposed by the acid solution; after twenty-four hours it yields gelatinous silica. Datolite should probably be transferred from column H of the Tables to column D.*

Hornblende, pyroxene, almandite, epidote, vesuvianite, and serpentine were decidedly decomposed in eight days; after one month hornblende, almandite, and epidote yielded coloured solutions and slimy silica, and serpentine gave gelatinous silica. After fourteen months' contact with the acid solution (occasionally agitated) the hornblende and pyroxene were very completely decomposed, the solutions having a dark brown colour and full of floating silica. Actinolite seems to be less easily decomposed than common black hornblende. The serpentine after fourteen months yielded a dry gelatinous mass.

The feldspars are very unequally attacked under similar conditions. Labradorite yields the easiest, decomposition being noticed after eight days, and slimy silica forming in the course of some months. Orthoclase and oligoclase showed marked signs of decomposition after eight months, but albite is doubtful. Tourmaline and staurolite yielded to the acid after four or five months, the latter forming a solution coloured by iron and slimy silica. Talc and kyanite appear to resist the action of citric acid.

Muscovite and biotite yield very slowly, the latter showing signs of decomposition the sooner. After two years' subjection to the acid solution very minute scales of mica separate, and some slimy silica appears in the slightly coloured liquid.

41. We have detailed these simple observations somewhat minutely because we believe they have an important bearing on geological disintegration and erosion. At the Saratoga meeting of the American Association for the Advancement of Science my friend Dr. Alexis A. Julien presented an exhaustive summary and analysis of all known observations, concerning the geological action of the humus acids.† In this paper he notes the negative character of the results I had obtained with a number of minerals, e.g., pyrite, augite, hornblende, the feldspars, micas, &c.,

and says—"But the nature and strength of the solvent employed and the brief duration of each trial seem at present insufficient to justify generalisations, notwithstanding the suggestiveness of certain results." My subsequent observations have confirmed his views. Generalisation is still of doubtful value, yet we are tempted to make the venture. In the following Table we have arranged the chief rock-forming minerals, with a few of their associates, under four heads indicating their relative disintegration by citric acid; the position of each mineral is of course only approximate, and it is not intended to indicate that all the species in one column are equal in degree of their decomposition. The application of this Table to the consideration of geological phenomena is a subject which I do not venture to discuss: if we have a right to assume that the disintegrating effect of the acids of humus differs from that of the other organic acids in degree rather than in kind, the Table may prove a small contribution to chemical geology.

TABLE
Showing approximate relative Disintegration of Rock-forming (and Associated) Minerals by Citric Acid in Solution.

Quickly Decomposed.	Slowly Decomposed.	Very slowly Decomposed.	* Not Decomposed.
Carbonates	Serpentine	Orthoclase	Quartz
Phosphates	Pyroxene	Oligoclase	Corundum
Prochlorite	Hornblende	Albite (?)	Spinel
Chrysolite	Labradorite	Biotite	Beryl
Nephelite	Garnet	Muscovite	Fluorite
	Epidote	Tourmaline	Barite
	Vesuvianite	Staurolite	Talc (?)
	Pyrite	Hematite	Kyanite (?)
	Limonite		
	Magnetite		
	Gypsum (?)		

DETECTION OF ANHYDROUS GLUCOSE MIXED WITH REFINED CANE-SUGAR.*

By P. CASAMAJOR.

I LATELY received from Chicago a sample of sugar suspected of being adulterated. The appearance of this sugar, and the sensation to the touch, were decidedly in favour of the supposition that starch-sugar had been mixed with it. The sensation to the touch is very characteristic of such mixtures. The person who sent the sugar described this sensation by saying that "it felt like ground cocoa-nut."

Upon applying to the suspected sugar several tests, which had been found efficacious in detecting common hydrated starch glucose, the following results were obtained:—

A test which was described before this Society at its meeting of March, 1880,† consists in stirring a suspected sugar with a small quantity of water. If any ordinary commercial starch glucose is present this will appear as chalky white specks, which are distinctly seen in the translucent mass of wet sugar. This test is worthless with crystallised anhydrous glucose, as the crystals of this substance have, when mixed with water into a paste, the same translucency as crystals of cane-sugar.

I also applied to the suspected sugar the test which consists in treating a sample of sugar with a saturated solution of starch glucose in methylic alcohol of density equal to 50° of Gay Lussac's alcohometer.‡ In the present instance the saturated glucose solution which I used was made from anhydrous dextrose. By washing the

* See Tables in *CHEMICAL NEWS*, vol. xliii., pp. 40 and 41.

† *Proceedings Am. Assoc. Adv. Sci.*, Saratoga Meeting, vol. xxviii., p. 311, 1879.

* Read before the American Chemical Society, February 2, 1883

† *Journal of the American Chemical Society*, vol. ii., p. 111.

‡ *Ibid.*, p. 428.

suspected sugar with this solution a small crystalline residue was obtained, which could not represent the total glucose present, as there was only 5 per cent, a quantity too small to pay for the trouble of mixing it with refined sugar.

The crystalline residue, placed under a microscope, showed the elongated square prisms characteristic of anhydrous glucose, a form which cannot be mistaken for crystals of cane-sugar, and still less for the thin plates of hydrated glucose.

Before proceeding with accounts of further tests, I must here withdraw a suggestion made by me before this Society in November, 1880,* to the effect that starch glucose, mixed with refined cane-sugar, could very likely be determined quantitatively by washing the suspected sugar with a saturated solution of starch glucose in methylic alcohol, and then weighing the residue. I suggested this process as one that might succeed, but one which I had not had occasion to try. The results which I have since obtained with this process show that the residue is much less than the quantity of starch-sugar originally present. This is undoubtedly owing to this, that after dissolving cane-sugar, the methylic solution acquires the property of dissolving additional quantities of starch sugar.

The sample of suspected sugar was also tested by the optical saccharometer. The direct test was 93.7 per cent. The solution was inverted, giving as a result 74.5 per cent of pure sugar. This result clearly showed adulteration by a dextro-rotatory substance. It does not, however, represent the actual quantity of cane-sugar present, as I will show, by examining the influence of anhydrous glucose in a case of this kind.

To study this influence I took 26.048 grammes of anhydrous glucose, which were dissolved in sufficient water to give 100 c.c. of solution. A portion of this being placed immediately in the tube of the saccharometer gave a deviation of 115.4 to the right. After standing in the tube for twenty minutes the deviation fell to 95.7; after two hours the deviation was 82.5. It was then allowed to stay over-night in the tube, and, fourteen hours after, the deviation had fallen to 78.8, which did not vary afterwards on standing for several hours. The solution was then heated to 68° C. with 10 per cent of its volume of hydrochloric acid, the operation taking about fifteen minutes.

This, after being neutralised with carbonate of soda, gave a deviation to the right still equal to 78.8. There had then been no change by treating with hydrochloric acid, which shows that the presence of dextrose is no bar to obtaining correct results by inversion, provided both observations, before and after inversion, are made after the deviating power of dextrose has reached a state of rest.

Returning to the test of the suspected sugar by the optical saccharometer, we have seen that the deviation to the right was at first 93.7 per cent. After standing in the tube fifteen minutes the deviation fell to 90.2. We have seen that the result obtained by inverting, after the first reading, was 74.5. This result is evidently too high, as the dextro-rotatory power of the dextrose present had diminished in the interval between the two observations.

Another sample of adulterated sugar was placed in the saccharometer as quickly as was practicable, after dissolving it in water. The indication was 100.4 per cent. As this sugar had all the appearance of a low sugar this indication was sufficient to show that it was adulterated. This solution was kept in the tube for further examination. Fifteen minutes afterwards the deviation had fallen to 94.3 per cent. Half-an-hour from the first observation, the reading was 91.6; one hour after, 90.2; two hours after, 89.9; three hours after, 89.7; five hours after, 89.3. After this there was no further variation. After inversion the indication was 72.7 per cent, which was considered as the correct percentage of pure sugar.

The optical saccharometer may, then, be considered as sufficient to determine if starch glucose is present in a

sugar, by observing the deviation immediately after getting the solution ready for the saccharometer, and repeating the observation at sufficiently wide intervals of time. If dextrose is present in notable quantities the deviation will decrease in a marked manner. Although the proof obtained in this way is satisfactory, it can only be applied by the very few persons who have saccharometers. To combat adulteration the best processes are those which can be easily applied by dealers and consumers who are unprovided with scientific appliances.

The following process can be applied by using such means as are at the command of everybody. It is applicable to the detection of adulteration with either anhydrous or hydrated glucose:—

Take two beaker glasses or two tea-cups. In one put a quantity of the suspected sugar, and in the other put about the same quantity of a sugar known to be refined sugar, free from adulteration.

Add, cautiously and gradually, a quantity of water to each sugar sufficient to make each equally and decidedly moist, and stir the sugar to mix it well and get it uniformly wet. Then place both cups in hot water. Any temperature between 50° and 100° C. will do. In about ten minutes the pure sugar will appear more moist than when cold, while the other sugar, if it contains a sufficient amount of starch glucose, will have sunk into a pasty, sticky mass, analogous to the *fill mass* of sugar refiners.

The application of heat is not indispensable, as a difference may be obtained by allowing the two sugars to stand several hours after being moistened, but with heat the effect is immediate, and is much more marked.

If the two samples of sugar are allowed to stand in the cups after they have cooled down, the pure sugar will look drier on becoming cold, while the adulterated sugar will continue in the state of a pasty, sticky mass.

This test is founded on the property possessed by cane-sugar to form viscous uncrystallisable compounds when mixed with many organic or inorganic substances, among which are anhydrous and hydrated dextrose. An example of compounds of this kind is *molasses*, obtained as a residuum in sugar manufacture.

As long as a mixture of cane-sugar and starch-glucose is sufficiently dry it may look fair enough, as the elements which form molasses are kept from combining by want of water. The sugar adulterator is well aware of this, and he is careful to dry his sugar before mixing with glucose. Indeed, one characteristic of adulterated sugars is that they are always drier than refined sugars of the same grade, which are known as *coffee sugars*, and are always sold moist.

As soon as sufficient water is added to an adulterated sugar, and moderate heat is applied, enough viscous syrup is formed to make the sugar sink into a paste, which remains permanently soft.

Useful indications may be obtained as to adulteration by starch-glucose, by means of Fehling's solution. An ordinary refined coffee sugar will rarely show more than 5 per cent of glucose, while a sugar adulterated with the usual dose of starch glucose will show about 20 per cent of glucose.

DETERMINATION OF PHOSPHORUS IN IRON AND STEEL.

By E. AGTHE.

FROM 0.5 to 1 gramme of the specimen, according to the quantity of phosphorus supposed to be present, is dissolved in 50 c.c. nitric acid; the solution is evaporated to dryness, the residue strongly heated, and afterwards—in order to expel the last trace of nitric acid—it is evaporated down again with hydrochloric acid. It is then re-dissolved in hydrochloric acid; so much hot water is added that

* *Journal of the American Chemical Society*, vol. ii., p. 429.

the silica may separate out; the solution is filtered into a porcelain capsule, and evaporated on the sand-bath at a high temperature as long as everything dissolves on shaking the capsule. It is then further evaporated as far as possible at a lower temperature; but no firm, solid, crusts must be formed. This evaporation must be conducted with especial care: if a little too much hydrochloric acid remains unevaporated the result will be too low, but if hard crusts are formed a clear solution cannot be obtained with nitric acid.

When cold, 35 c.c. ammonia of sp. gr. 0.96 are added and stirred up with a glass rod, so that a thick paste is formed. 75 c.c. nitric acid of 1.2 sp. gr. are then added; the capsule is set in a warm place and stirred to promote solution. The solution is rinsed into a beaker, and when no longer too hot, from 50 to 100 c.c. molybdic acid added, well stirred; the beaker set in a warm place (not above 80° for four hours, let cool, filtered, and washed with dilute molybdic solution. The washed precipitate is dissolved upon the filter in a minimum of ammonia, and the ammoniacal solution is mixed with hydrochloric acid till the precipitate formed re-dissolves with difficulty. When the beaker is quite cold, 15 to 25 c.c. magnesia mixture are added; the whole is well stirred, filtered after standing for six hours, slightly washed with ammoniacal water, dried, ignited, and weighed. The filtrate from the ammonium phospho-molybdate is mixed with ammonia, and set for four hours in a warm place, observing if a further yellow precipitate is formed. If this is the case the analysis is defective; the liquid is then neutralised as far as possible with ammonia, more molybdic solution is added, and the second precipitate is weighed along with the former.

The author prepares his molybdic solution by dissolving 115 grammes molybdic acid in 460 ammonia at 0.96 sp. gr., adding 1 litre water, and pouring this solution into nitric acid of sp. gr. 1.2. The liquid is let stand for a day and filtered.

For magnesia-mixture he takes magnesium chloride 101.5 grms., ammonium chloride 200, liquid ammonia 400 grms. (sp. gr. 0.96), and water 1 litre.—*Zeitschrift für Analytische Chemie*.

VOLUMETRIC DETERMINATION OF FERRO-CYANOGEN IN CRUDE PRUSSIAN.

By J. TCHERNIAC.

THE author employs a saturated solution of potassium permanganate; a standard solution of the same salt, of which 1 c.c. corresponds to 1 decigram. of potassium ferrocyanide; and a solution of ferrous sulphate containing 50 to 100 grammes per litre.

A measured quantity of the solution in question, containing about 3 grms. ferrocyanide, is made up to 500 c.c. with sulphuric acid in a thin measuring flask, and mixed with so much of the saturated permanganate that the red colour does not disappear after agitation for some minutes. The whole is allowed to stand for about half an hour: after the oxidation is complete caustic soda is added in large excess, and the whole is heated to a boil, with constant stirring. The hot solution is mixed with so much ferrous sulphate that the precipitate is coloured black by the ferroso-ferric oxide liberated, let cool, filled up to the mark, and filtered. In an aliquot part of the filtrate (250 c.c.) the quantity of the ferro-cyanogen re-formed by the ferrous sulphate is determined by titration with the standard permanganate, after acidulation with sulphuric acid.

In case of mother-liquors containing 15 per cent or less of potassium ferrocyanide, 10 c.c. are poured into 70 c.c. of alcohol at 95 per cent, to which a little acetic acid has been previously added. The precipitated ferrocyanide is washed with alcohol at 90 per cent until the washings are

neutral, dried at 100° on the filter, dissolved in water, and titrated with permanganate solution.—*Zeitschrift für Analytische Chemie*.

DETERMINATION OF TOTAL TARTARIC ACID IN CRUDE TARTAR, &c.

EXACTLY 3 grammes of the finely ground sample are mixed in a small beaker with 30 to 40 c.c. water and 2 to 2.5 grammes potassium carbonate, and boiled for ten to twenty minutes, constantly stirring. The acid potassium tartrate and the tartaric acid combined with calcium are thus converted into neutral potassium tartrate. The whole is introduced into a measuring cylinder or flask holding 100 c.c., cooled, made up to 100 c.c., shaken up, and after standing for some time, filtered through a dry filter into a dry flask. 50 c.c. of the filtrate are then evaporated down to about 10 c.c., mixed with 2 c.c. glacial acetic acid, and from 100 to 120 c.c. of alcohol at not less than 95 per cent. To effect the complete separation of the bitartrate, the whole is well stirred for some time, and after standing is filtered. The residue is washed with alcohol at 95 per cent until the washings which run off after dilution with water no longer show an acid reaction. The moist precipitate, together with the filter, is returned to the capsule, stirred up with water, heated to a boil, and titrated with normal soda. The number of c.c. consumed multiplied by ten gives the percentage of hydrated tartaric acid in the sample.—*Zeitschrift für Analytische Chemie*.

ON ALGIN: A NEW SUBSTANCE OBTAINED FROM SOME OF THE COMMONER SPECIES OF MARINE ALGÆ.*

By EDWARD C. C. STANFORD, F.C.S.

THE utilisation of hitherto waste materials presents a large field for chemical investigation, and many important industries have within the last twenty years resulted from such researches.

There are few materials so abundant, so general, and so easily obtained as the commoner kinds of sea-weed thrown up on all our coasts, but especially on those exposed to the waves and storms of the Atlantic. The species I refer to—the laminaria and fuci—are found growing on all rocky shores. And it may also be remarked that, except as manure, the great bulk of this material has been long practically unutilised. It is true that, when burnt into the rough slag known as kelp, this material was formerly the means of securing large revenues to the proprietors of the western islands. For several well known reasons, that manufacture has long ceased to be profitable, and it never could have been considered as utilising the sea-weed, except in the sense that burning down a forest could be called utilising it, when it ought to be cut into timber and really utilised in building houses or making furniture.

In 1862 the writer introduced a method of carbonising the sea-weed in retorts, and thus converting the material into charcoal instead of kelp, and preventing the great loss of iodine arising from open-air burning. This was simply another step of improvement, and comparing it again with the forest, was merely equal to making the timber into charcoal instead of burning it into ash. It is not, in a proper and fuller sense, utilising the sea-weed. The results of further attempts in this direction form the subject of this paper. When we remark that the present widespread destitution and want of employment amongst the

* Read before the Chemical Section of the Glasgow Philosophical Society, April 2, 1883.

poor cottars is most severe in just those districts in Ireland and the Highlands where this material is most abundant, the importance of this inquiry will be at once seen. Indeed, if a remunerative price can be paid for a waste material that every child in a large family can easily assist in collecting at their own doors, it would go far to settle many existing difficulties, of which the worst is always hunger. And this brings me to mention the value of the algæ as a food material. In my paper read before the Society of Arts in 1862 on "The Economic Applications of Sea-weed," the various kinds so used were described, and I have called attention more recently, in a paper read before the Chemical Society, to the fact that the analysis of the charcoal obtained from the various algæ approximates more nearly to that of a product of the animal than of the vegetable kingdom. I believe the algæ generally to be quite as valuable food products as the fungi, with the advantage that we are unaware of any poisonous species. Both are, however, equally neglected in this country. As the edible fungi are much consumed by other European nations, so the edible algæ are largely enjoyed and realise a high price in China and Japan. A sample of one of the Japanese varieties before us yielded on analysis a composition closely similar to our laminaria. It has, however, evidently been cut up, and presents the appearance of long shreds, and is coloured green by the action of an alkali. The poor people in Donegal are now eating the *Fucus vesiculosus* with Indian meal, and it is a common thing to see the Highland cattle browsing on this plant at low tide. The *Alaria esculenta* or murlins, of which a fine specimen is on the table, may be called our edible species, but the *Rhodomenia palmata*, or dulse, is perhaps better known in Glasgow, being regularly sold in the streets.

The most important species consumed in this country is the *Chondrus crispus* or Irish moss. This plant contains 79 per cent. of caragheenin, a substance of great gelatinising power, and largely used in jellies and puddings. This seaweed would, no doubt, secure a considerable market as a size for fabrics, but it cannot be obtained in any great quantity. It is only uncovered at low spring-tides, and any very large demand would soon exhaust the supplies. A recent application of Irish moss is being worked by a limited company under the name of veloplast, which is said to be made of refuse leather, dried and finely ground and mixed with caragheenin. I am indebted to Mr. John A. Walker, of Dublin, for specimens of green and yellow morocco, poplin, and satin damask, and watered silk, all of which appear to be most successful imitations. The new substance to be described in this paper would probably answer equally well for this application.

Another still more powerful gelatinising substance is gelose. This was first imported into France from China in 1856. It has ten times the gelatinising power of isinglass, and will set into a jelly 500 times its weight in water. It is not nitrogenous, and contains—Carbon, 42.8; hydrogen, 5.8; oxygen, 51.4. It has not superseded isinglass for jellies, as the fusing-point of the jelly is too high to melt in the mouth. I found some years ago, in experiments on every variety of sea-weed that could be procured, that this gelatinising principle was confined to two British species—the *Chondrus crispus* and the *Gelidium cornutum*. An Australian alga, the *Euchemia spinosa*, or agar agar, is also a jelly-yielding species. Several articles have recently been introduced under various names, such as thao, fucyne, &c., all of which appear to be modifications of, or products from, these plants.

The application of sea-weed as manure is very general where it can be obtained. In fact the practical value placed on it is far above its actual chemical valuation. It usually contains 80 per cent. of water, so that four tons of water are carted to the land for every ton of dry sea-weed, and even when dried there is not a large saving in carriage, and it is then very bulky. It is, however, carried long distances in some places, and there is no doubt that it is

very valuable on soils that are all sand; but it is more of a mechanical value, as its use is not to *manure* but to *make* the soil—a rather expensive manufacture. Kelp waste—a ton of which, dry, represents 40 tons of wet sea-weed, and contains all the phosphates of the weed in a convenient form—is absolutely unsaleable to farmers in this country at any price.

The only other important proposed application of seaweed has been to the manufacture of paper, and about 20 years ago several patents were taken out with this object, and some specimens were exhibited at the Society of Arts on the occasion before referred to. They were all made, however, from the *Zostera marina*, or grass wrack—a marine plant with flowers growing in the sea, but not one of the algæ—and this plant makes a very good paper. It created a good deal of attention at that time, having been proposed as a substitute for cotton during the cotton famine. It is not, however, available in large quantity, and contains very little fibre. The algæ generally contain no fibre, but, as far as my experiments have gone, nearly every species yields a very pure cellulose, which makes a tough, rather transparent paper. The tissue of the plant consists of simple cells of various shapes laid end to end, and in the fuci containing a dark pigment. This cellulose fabric, which forms the paper material, amounts, when quite dry, to 10 per cent. of the air-dry plant. In working on the fuci and laminaria, my attempts to make a paper pulp were much impeded by a peculiar substance common to both these species, which was found at first difficult to remove, and the presence of which rendered the paper brittle. In fact this appeared to be always the case unless the cellulose was obtained quite pure. This substance is present in large quantities, and forms the bulk of the plant.

Any one observing the long flat fronds of the laminaria after the salts are removed lying on the sea shore must have noticed two things—1st, that these are easily bleached by exposure to light; 2nd, that, after exposure to rain, the fronds contain in their interior sacs of fluid. These are derived from the endosmosis of the water through the outside membranes, dissolving a peculiar glutinous principle. Upon opening one of these sacs, a neutral, glairy, almost colourless liquid escapes. Sometimes it may be seen partially evaporated on the surface of the frond as a jelly-like substance, which may be drawn out by the fingers in long, tenacious strings. This fluid contains a unique substance of remarkable properties, and to which, from its source, I have given the name of algin. The vesicles are only seen in the long fronds of the various laminaria, especially *L. Henophylla*, known in the Highlands as bardarrig, or red-top. The large stems or tangle, and the fuci, although containing it in considerable quantities, do not exhibit this appearance.

If the liquid be evaporated to dryness, the scales so produced resemble albumen, and are not all soluble in water, but very soluble on the addition of a little alkali. Several other instances of the solubility of substances when endosmosed or dialysed are well known. The fluid thus naturally obtained is miscible with water, but coagulated by alcohol and by mineral acids. It cannot be obtained in sufficient quantity for exhaustive analysis, but it contains calcium, magnesium, and sodium, in small quantity, in combination with algin. If the laminaria fronds are cut up and macerated in dilute hydrochloric acid, the liquid in the vesicles assumes the form of a colourless, insoluble jelly. If the laminaria fronds are immersed in water containing a little alkali—by preference sodium carbonate—the whole plant becomes disintegrated, and presents a gelatinous mass, consisting of a thick, glutinous, gummy liquid, containing the cellular fabric of the plant completely broken up. This occurs in 24 hours in the cold. The mass, although it only contains 2 per cent. of the algin, is so glutinous that it cannot be poured out of the bottle. It is very difficult to deal with, on account of its extraordinary thickness. In fact, as it is, no method of filtration is possible (all known methods, with and with-

out pressure, have been tried). The cells to be removed are so minute that, if pressure be applied, the whole mass passes through any filter or not at all. By cautiously heating the mass, it can, however, be filtered. The medium employed is a coarse linen sacking in the form of a Taylor's filter. The cellulose is left behind as a gelatinous mass, amounting, when dry, to about 10 per cent. of the air-dried plant.

The algin solution is then evaporated in a somewhat similar manner to gelatin, and, when dry, presents an appearance which is not unlike gum tragacanth; but it may also be obtained in thin transparent flexible sheets. The solution is slightly alkaline; but care must be taken that no great excess of sodium carbonate is present, or the solution decomposes, and in a week, if dilute, becomes quite thin, and contains no algin. This action of the alkali I cannot yet clearly explain. The solution can be neutralised by the careful addition of hydrochloric acid without gelatinising; but an excess at once precipitates it. A solution of only 2 per cent. becomes semi-solid, treated in this way. The following reactions are obtained with various reagents. For some of these the solution must be carefully neutralised with acetic acid, which does not gelatinise it.

Dilute hydrochloric, nitric, sulphuric, sulphurous, phosphoric, and mineral acids generally, coagulate it. Boracic acid has no effect.

Lime water, baryta water, and salts of calcium, barium, and strontium give white precipitates.

Salts of magnesium do not affect it. Acetic, formic, citric, tartaric, and benzoic acids do not affect it.

It is precipitated by alcohol.

Perchloride of iron gives a dark brown coagulum.

Salts of copper, zinc, aluminium, tin, antimony, cobalt, and nickel all precipitate it.

Protonitrate of mercury forms a white precipitate, but bichloride of mercury and silver nitrate have no effect.

Acetate and subacetate of lead both give white precipitates.

Potassium silicate and bichromate, sodium biborate, and potassium ferro-cyanide, permanganate, sodium tungstate, stannate, and succinate do not affect it. No precipitate is produced by tannin.

Concentrated sulphuric acid dissolves it; concentrated nitric acid converts it into oxidation products, amongst which are oxalic acid, of which a specimen from this source is exhibited.

It is distinguished from albumen by not coagulating on heating, and by not precipitating silver nitrate—from gelose by not gelatinising on cooling, and by containing nitrogen, which gelose does not; and being soluble in cold, weak, alkaline solutions, which gelose is not; and being insoluble in boiling water, in which gelose is soluble. The laminaria has been boiled in water for a month without effecting any solution, and for a week under 40 lbs. pressure with a similar result.

It is distinguished from gelatine by not giving any reaction with tannin—from starch by giving no reaction with iodine; from dextrine, gum-arabic, gum tragacanth, and pectin by its insolubility in dilute alcohol and in dilute mineral acids.

I notice as particularly remarkable that it should precipitate all the salts of the alkaline earths except those of magnesium, and most of the metals except silver and mercury, and with regard to the latter that it should precipitate the protonitrate but not the bichloride; and that it gives no precipitate with potassium silicate.

The gelatinous precipitate produced by a mineral acid represents the algin in its pure insoluble form. It dries up to a hard, horny substance. The specimen shown can scarcely be distinguished from horn. I have not yet succeeded in getting it pure and definite enough to be certain of its composition; but I am indebted to Professor Ferguson for a combustion of the soda compound. This had been carefully dialysed to avoid the presence of excess of alkali, and gave the following numbers:—

Carbon	35'65
Hydrogen	4'40
Nitrogen	3'03
Oxygen	37'23
Ash	19'69 = sodium carbonate.
<hr/>	
100'00	

This gives the following composition for the algin. I have appended also that of gelatin, isinglass, gelose, and chitin. In nitrogen it is intermediate between gelose and gelatin, but it approaches nearer to chitin than any other substance. Fremy, however, denies the presence of nitrogen in this substance. It differs entirely from algin in being insoluble in alkalies.

	Algin.	Gelatin.	Isinglass.	Gelose.	Chitin.
Carbon	44'39	50'0	50'1	42'77	46'64
Hydrogen	5'47	6'5	6'6	5'77	6'60
Nitrogen	3'77	17'5	18'3	—	6'56
Oxygen	46'37	26'0	25'0	51'46	40'20
<hr/>		<hr/>	<hr/>	<hr/>	<hr/>
	100'00	100'0	100'0	100'00	100'00
(Sulphur, 0'12.)					

The percentage of ash in the soda compound does not materially vary. The two following were made—one with sodium hydrate, and the other with sodium carbonate—and yielded almost the same amount of ash:—

Sodium hydrate—percentage of ash ..	31'51
Sodium carbonate do. ..	31'37
<hr/>	
Mean	31'44

Although I believe the composition to be stated correctly, I cannot construct a formula from these figures; and all attempts to procure definite compounds for analysis have as yet been unsuccessful. The following salts have been prepared and investigated with this view:—Compounds with calcium, aluminium, barium, and lead—but the results have not been uniform enough to show that we have been examining definite compounds.

The sodium carbonate appears to be unaltered in the compound, but completely masked. The carbonic acid comes off only when acidified with an excess of hydrochloric acid, and heated.

The acid has also some decomposing effect, and produces a small quantity of a substance which precipitates Fehling's solution, but does not appear to be glucose.

A solution, 1000 grs. measure, containing 13'2 grs. of algin, was precipitated by standard sulphuric acid, and re-dissolved by standard sodium hydrate, six times in succession.

1st precipitation took of sulphuric acid (SO ₃), grs.	5'430
2nd	4'070
3rd	3'086
4th	1'975
5th	0'617
6th	0'617
1st resolution took of soda (Na ₂ O), grains ..	3'778
2nd	2'871
3rd	2'052
4th	1'530
5th	0'670
6th	0'478

As the precipitate is not soluble in sodium sulphate, there appears to be some decomposition continually going on, and this has not yet been sufficiently investigated to enable me to ascertain the exact action of the hydrochloric acid.

The process proposed to deal with the sea-weed is first of all to wash out the salts by simple maceration in cold water. This is very easily done, the salts being almost entirely removed, even by two macerations. On account of the bulk of the material it is, however, advisable to

wash a number of vats exhaustively in turns, in the usual manner of lixiviation common in alkali works. The water removes about a third of the weight of the sea-weed, and when evaporated to dryness presents a treacly mass containing the salts and a considerable quantity of a saccharine matter which resembles mamite, but which precipitates Fealing's solution equal to 15 per cent of glucose. It is, however, unfermentable, and I have not yet succeeded in getting it pure enough for analysis, on account of the great difficulty of separating it from the alkaline chlorides which are soluble in alcohol. By the use of sulphate of silver I have separated a small quantity, but still not sufficiently pure. If this can be separated commercially, and is a sugar having sweetness but unfermentable, it would be available for replacing glycerine in some of its applications. Until, however, more is known of its properties it must be sacrificed by carbonising the salts, the charcoal, of which it yields about 50 per cent, being then treated in the usual manner for separating the iodine and salts. The salts vary from 35 to 55 per cent of the whole; or 12 to 18 per cent. of the original air-dry weed in the laminaria. This is more than is obtained by burning the weed into ash, which does not, as a rule, yield more than 10 per cent of salts on the air-dried weed.

(To be continued.)

NOTICES OF BOOKS.

The Explosives Act 1875, and the Orders in Council of April 20th, 1883, their Prejudicial Effect on Mining and Quarrying, and the Encouragement they give to Fenians. London: A. P. Blundell and Co. 1883.

THE pamphlet before us is anonymous, and yet we think we could supply the author's name. He criticises the "Nitro-glycerine Act" of 1869, the "Explosives Act" of 1875, and the Act of the present season as calculated to do more harm than good. But we do not see what regulations he proposes to substitute, and we even suspect that he would wish the trade to be thrown open. He speaks of the "annoyance and loss" which recent legislation will occasion to persons requiring explosives for legitimate purposes. But he apparently forgets that these legitimate purposes are exceedingly few, being confined to quarrying, mining, and blasting in engineering operations. We believe that, by a foolish trade custom, miners and quarrymen have been in the habit of buying their own blasting-agents, and keeping the same in their dwellings, or in huts near the works. This custom should be abolished: the explosives should in future be bought and stored by the employer only, who would be held responsible for their safe-keeping, and served out to the workmen only when and as required. This simple change would do away with no small part of the author's contention. It must further be remarked that, in coal-mining at least, the use of explosives is being reduced, in consequence of the introduction of the lime-cartridge.

The author thinks it inconsistent that the recent regulations should not extend to gunpowder, which "may be used with powerful effect for malicious purposes." True, but nitro-glycerine, being much stronger than gunpowder, may be more easily secreted and carried about without attracting attention. He thinks that evil-disposed persons, "not being able to obtain such explosives in any other way, have been obliged to manufacture them themselves." Precisely, and this is a great gain to the community. The public enemy is thus put to much greater trouble and expense, and the chances of detection are indefinitely increased. Even in regular manufactories of the nitriles, with all the advantages of experienced workmen and well-arranged plant, accidents are not rare. Much more likely are such catastrophes to happen when amateurs are working in a stable, a kitchen, or a shed, and any such accident

must at once lead to detection. Even the smell, and much more the colour, of nitrous fumes escaping should at once arouse the vigilance not merely of the police, but of the neighbours. We have often thought it exceedingly inconsistent that stringent regulations should be enforced concerning the sale of poisons, whilst the trade in explosives should be practically free. Yet explosives, in bad hands, are capable of effecting far more widespread damage than any poisons, whilst the legitimate uses of many of the latter are far more numerous and varied than those of dynamite, or even gunpowder.

Proceedings of the American Pharmaceutical Association at the Thirtieth Annual Meeting, September, 1882. Philadelphia: Sherman and Co.

THE first thing which strikes us in this volume is the second of the "Queries to be answered at the Thirty-first Annual Meeting, to be held at Washington during the coming summer." It runs:—"It has been said that if snow, formed in any month but April, be melted and bottled, the water will become ropy; but that snow which falls during the month of April, on the contrary, will furnish water which will remain limpid the summer through, and which can be used by pharmacists and photographers. Experiments on this subject are desired." This remarkable question has been undertaken by Mr. G. W. Sloan, of Indianapolis, and we shall look forward not without curiosity to his report.

Under the heading "Report on the Progress of Pharmacy" we observe a very extensive selection of valuable matter, some of which, however, such as a "safety-paper for cheques" and a black varnish for leather, have no very obvious connection with pharmacy.

Considerable space is devoted to the Pharmacy Acts of various States of the American Union. Some of these laws must, we should think, be found very inconvenient for the multitudes of persons who require poisons for scientific and technical purposes. The trade in such articles as the mineral acids, oxalic acid, ammonia, zinc and copper sulphates, lead acetate, &c., seems to be restricted to pharmaceutical chemists, with the necessary consequences. The seller is "not to deliver any of the said poisons to any person without satisfying himself that such poison is to be used for legitimate purposes,"—a very indefinite, and at the same time very difficult, stipulation. The penalties are in some cases heavy. We do not find in these Acts any mention of the soluble salts of barium, or of the soluble chromates, compounds quite as deadly as many of the substances included in the schedule. Nor is the common sale of explosives deemed a matter which requires legislative regulation.

CORRESPONDENCE.

THE AMMONIO-PHOSPHATIC DEPOSIT IN THE VICINITY OF CAPE TOWN.

To the Editor of the Chemical News.

SIR,—If Mr. Griffiths has made a full analysis of the above substance, I am sure the publication of it would interest many chemists.—I am, &c.,

HUANO.

Examination of a Double Sulphate of Iridium and Potassium.—Lecoq de Boisbaudran.—An examination of the green insoluble matter obtained on dissolving in water charged with neutral potassium sulphate the product formed on treating iridium compounds with potassium bisulphate at dull redness. This compound, though insoluble in saturated solution of potassium sulphate, is soluble in pure water.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 20, May 14, 1883.

Pyro-electricity of Quartz.—C. Friedel and J. Curie.—The authors have obtained, by heating, tensions of the same sign as those which M. Hankel has observed on refrigeration. In common with M. Röntgen, they conclude that the modes of development of electricity, distinguished by M. Hankel as *thermo*-, *actino*-, and *piezo-electricity*, are due to the same cause. According to M. Röntgen this cause is a change in the internal tensions of the crystal. The authors regard it as a change in the molecular distances.

Cultivation of the Cacao Tree: Researches on the Constitution of Cacao-beans and of Chocolate.—M. Boussingault.—The author gives as the result of a qualitative examination of cacao from Trinidad: Fatty matter, starch, theobromine, asparagine, albumen, gum yielding mucic acid, tartaric acid (free and combined), soluble cellulose, ash, and matters not determined. The composition of a genuine chocolate, which he used on his journeys in South America, is—

Sugar	20
Fatty matter	41
Albumen	10
Phosphate	3
Other matters	26

100

Possibility of extending to any Surfaces whatever the Electro-chemical Method of Figuration of Potential Distributions.—A. Guebbard.—This memoir does not admit of useful abstraction.

Determination of Carbon Disulphide in the Sulpho-carbonates.—A. Müntz.—This paper cannot be intelligibly reproduced without the accompanying figure.

Zeitschrift für Analytische Chemie.
Vol. xxii., Part 2, 1883.

Application of the Various Methods for the Determination of Vapour Densities.—V. Meyer.—From the *Berichte Deutsch. Chem. Gesell.*, xv., p. 2775.

Influence of Gum Arabic upon certain Reactions.—Jules Lefort and P. Thibault.—From the *CHEMICAL NEWS*.

A Pressure-Regulator for Determinations of Boiling-Points.—W. Städel.—A modification of the apparatus described in the *Zeitschrift*, vol. xviii., p. 574.

Apparatus for Registering the Disengagement or Absorption of Gases.—P. Regnard.—From the *Comptes Rendus*, xcv., p. 77.

Apparatus for Reducing Measured Volumes of Gases to the Normal Condition without taking the Temperature and Barometric Pressure.—Jos. Barnes.—From the *Journal of the Chemical Society*.

Preparation of Oxygen at Common Temperatures.—A. Guyard.—From the *Moniteur Scientifique* (3, 12, p. 781).

Electrolytic Behaviour of Thallium, Indium, Vanadium, Palladium, Molybdenum, Selenium, and Tellurium.—L. Schucht.—Already inserted.

Separation of Iron from Nickel and Cobalt.—T. Moore.—From the *CHEMICAL NEWS*.

The Solubility of Mixtures of the Salts of the Alkalies and Alkaline Earths at Different Temperatures.—H. Precht and B. Wittjen.—The authors give their results in tables, which may be found in the *Berichte* (xiv., p. 1667).

Determination of Chrome as Chromium Phosphate.—A. Carnot.—From the *Bulletin de la Soc. Chim. de Paris*, 37, p. 482.

Volumetric Determination of Chromium and Manganese in Presence of Ferric Oxide and Alumina.—E. Donath.—From the *Berichte*, xiv., p. 982. Already inserted.

Behaviour of the Salts of Gallium.—Lecoq de Boisbaudran.—From the *Comptes Rendus*.

Specific Gravity of Mercury.—P. Volkmann.—At 0° the sp. gr. of mercury is 13.5953.

Detection of Traces of Platinum.—F. Field.—From the *CHEMICAL NEWS*.

Quantitative Determination of Antimony.—A. Weller.—From *Liebig's Annalen*.

Volumetric Method for the Determination of Boric Acid.—E. F. Smith.—From the *American Chemical Journal*, iv., p. 279.

Specific Gravity of Hydrobromic Acid at Different Strengths.—J. Biel.—From the *Pharmaceutical Journal*.

Behaviour of certain Organic Compounds with Magenta-Sulphurous Acid.—J. Schmidt.—This paper will, if possible, be given in full.

Solubility of Different Modifications of Tartaric Acid.—E. Leidie.—From the *Comptes Rendus*.

Determination of Total Tartaric Acid in Crude Tartar.—MM. Goldberg and Geromont.—This paper will be inserted in full.

Determination of Glycerin in Fats.—J. David.—From the *Comptes Rendus*.

Detection of Salicylic Acid in Milk.—Ch. Girard.—100 c.c. water at 60° and 100 c.c. of the sample of milk are mixed with eight drops acetic acid and eight drops mercurous nitrate, shaken up and filtered. The filtrate is shaken up with 50 c.c. ether, which takes up the salicylic acid. After the evaporation of the ethereal solution the usual reagents can be applied to the residue.

Microscopic Examination of Flour.—The microscopic researches of L. Wittmack and A. Tomaschek are merely mentioned.

Determination of Starch-Syrup in Brown Sugar-Syrup.—P. Casamajor.—From the *CHEMICAL NEWS*.

Determination of Wool, Silk, and Cotton in Tissues.—A. Rémont.—This paper will be inserted in full.

Determination of Phosphorus in Iron.—E. Agthe.—(See page 253.)

Examination of the Ethereal Oils.—This memoir is not susceptible of useful abstraction.

Distinction of Olive Oil from Cotton-seed Oil.—Mr. Conray.—From the *Pharmaceutical Journal*.

Valuation of Potassium Sulpho-carbonates.—G. Dannecy.—From the *Journal de Pharmacie*.

Recognition of Genuine Beech-Tar Creosote.—H. Hager.—This paper will be inserted in full.

Determination of the Alkaloids of Cinchona Barks.—H. Meyer.—The author has studied the various methods of Prollius, Maens, De Vrij, Støder, Eykmann, Hager, and Gunning.

Detection of Mercury in Animal Matter.—H. Paschkis.—The author defends the process of E. Ludwig against the objections of V. Lehman.

Detection and Determination of Aceton in Urine.—R. von Jaksch.—This paper does not admit of useful abstraction.

Determination of Urea with Sodium Hypobromite.—J. R. Duggan.—From the *American Chemical Journal*.

Determination of Glycogen.—E. Kulz.—The ordinary process assumes that this body can be completely thrown down from its aqueous solution by absolute alcohol. As this is not the case in the absence of mineral matter the author proposes to add a trace of sodium chloride.

New Urinary Pigments.—Two colouring-matters are here mentioned, which require further examination.

Behaviour of Urine with Diazo-benzol.—P. Ehrlich.—In certain pathological urines the diazo-compounds produce characteristic reactions.

Re-calculation of the Atomic Weights.—F. W. Clarke.—An abstract of Part V. of the "Constants of Nature."

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xii., Part 4.

Solid and Gaseous Constituents of Sea-water, and on Oceanic Deposits.—Hercules Tonroe and L. Schmelck.—The questions raised were: Are differences in the respective proportions of the constituents perceptible in specimens of sea-water drawn at different places? If so, is any regularity to be traced in such differences? The oceanic region examined extended from 60° to 80° North Lat., and from 12° W. to 37° E. Long. from Greenwich. Lime, magnesia, sulphuric acid, and chlorine were determined in all the samples; potassa only in some few instances. Sodium was not determined, as a change in the proportion of sodium chloride would have been detected by the sp. gr. The specimens of water drawn at different depths and at remote points, evinced but very slight differences in composition. Certain deviations in the sp. gr. and in the total solids were due to a dilution of the sea-water, owing to the continued introduction of ice, or of fresh water, but the respective proportions of the various salts remained normal. The results support the generally accepted view of the approximately identical composition of the ocean throughout its extent. The percentage of organic matter is very small: 0.0025 gm. in 100 c.c. Hydrogen sulphide was never detected. If sea-water is boiled for some hours, constantly replacing the loss by evaporation, there is formed a precipitate of magnesium oxide perfectly free from lime, and the total carbonic acid is expelled. But, if sea-water is concentrated to half its original volume, only about half of the carbonic acid escapes, the precipitate consists of calcium carbonate and sulphate. On further concentration, calcium sulphate and sodium chloride are deposited, but even when the bulk of the latter is thus eliminated the mother-liquor contains all the potassium and magnesium salts. In determining the gaseous constituents of sea-water, the authors, like Buchanan, found the proportion of oxygen increased on approaching the pole. The oxygen decreases on descending, at first rapidly, and then more slowly, reaching its minimum at 1000 metres; it then slowly re-increases. The strata richest in saline matter are poorest in nitrogen. The remarks on the deposits at the bottom of the ocean belong rather to geology than to chemistry.

The Lupitz System of Farming and its Scientific Foundations.—MM. Schultz, Drechsler, Blomeyer, and Märcker.—The system depends on utilising the "source of nitrogen available in the atmosphere." As evidence of the value of this source he mentions a field of lupins, which received annually per acre 3 cwts. kainite, and yielded for fifteen years in succession not less than 6 cwts. seed and 12 cwts. straw per acre. A dose of 20 lbs. soluble phosphoric acid per hectare, four times repeated, was without effect. The author contends that the plants which collect nitrogen leave more of this ingredient in the soil if reaped when ripe than when green. Here he agrees with Voelcker, Pierre, and Déhérain, who

have observed in ripening plants a recession of nitrogen and phosphoric acid from the tops of the plant to the roots. The chief collectors of nitrogen, besides lupins, are clover, tares, peas, and lentils. None of the authors admit the assimilation of free atmospheric nitrogen as possible. Prof. Märcker suggests that the store of nitrogen in the soil and the quantity derived yearly from the atmosphere may be greater than is commonly assumed. It is also suggested that carnallite may be found superior to kainite as a manure, from the circumstance that it contains its potassium, not as sulphate, but in the preferable form of chloride.

Researches on Sea-Mud.—Dr. M. Fleischer.—A chemical and physical analysis of the mud dredged up from harbours and estuaries on the coasts of Germany and Holland.

Action of Various Manures upon Potatoes.—Russell Swanwick and E. W. Prevost.—From the *Transactions of the Highland and Agricultural Society of Scotland*.

Occurrence of Myronic Acid and Determination of Mustard Oil in the Seeds of the Cruciferae and in Oil-cake.—V. Dircks.—The author grinds up the seeds or the press-cake, introduces the powder into a retort, adds water, and connects the retort with a condenser and with one or two Will's absorption apparatus charged with an oxidising solution of 50 grammes permanganate and 120 grms. sodium hydroxide per litre. After the retort has stood for some time at a moderate temperature in the water-bath it is heated, and a current of air and one of hot steam are passed simultaneously through the apparatus. The liquid in the receivers is finally heated for some time, concentrated, mixed with strong hydrochloric acid, and evaporated to dryness; the residue is taken up with water and a few drops of hydrochloric acid, filtered, and, lastly, the sulphuric acid which has been formed is determined by precipitation with barium chloride. As the barium sulphate is contaminated with manganese it is fused with soda and saltpetre, the green melt evaporated to dryness, the manganese is separated by means of sodium acetate and bromine water, weighed, and deducted from the barium sulphate.

Justus Liebig's Annalen der Chemie,
Band 217, Parts 2 and 3.

On the Nitration of the Phenol-ethers.—W. Staedel.—In this very extensive memoir the author treats of the nitration of ortho-cresol-ethyl-ether, of the corresponding dinitro-compound, of dinitro-ortho-cresol; the nitration of meta and para-cresol-ethyl-ether, of the ethyl- and methyl-naphthol-ethers, the trinitro-naphthylamines, trinitro-naphthalines, and the nitration of the benzyl-ethers.

Nitro-phenols and Nitro-cresols.—W. Staedel.—We have here an account of dinitro-phenol-mono-nitro-benzyl-ether, of dinitro-ortho-cresol, mononitro-benzyl-ether, of the dinitro-ortho- and para-cresol-ethyl-ethers, of the preparation of symmetric-dinitro-toluol, the oxidation of sulpho-dinitro-toluol, yielding dinitro-benzoic acid, the reduction of sulpho-dinitro-toluol and para-nitro-benzyl-nitrate.

Amido-cresol-ethyl-ether.—W. Staedel.—The author gives his results in the form of a table.

Compounds of Benzo-trichloride with the Phenols and the Phenylamines.—Oscar Dœbner.—The compounds of benzo-trichloride with the phenols and phenylamines have the property in common with the previously known hydroxyl- and amido-derivatives of triphenylcarbinol that they are all colouring-matters in the wider sense of the word, so that triphenylcarbinol appears as the bearer of the colour-forming element. A further agreement in all is the transition under the influence of reducing agents, into the hydroxyl and amido-derivatives

of triphenyl-methan, which are colourless. Recent investigations have shown as derivatives of triphenyl-methan, the phthaleines, aurine and its homologue, rosolic acid, eupitonic acid, rosaniline and its derivatives. To them are joined the compounds of benzo-trichloride with the phenols and phenylamines, characterised by containing an intact phenyl group.

Communications from the University Laboratory of Halle.—These papers, all by E. Schmidt, treat of the action of hydrochloric acid upon caffeine, of theobromine, of the occurrence of caffeine in cacao, and the action of hydrochloric acid upon xanthine.

Contributions to a Knowledge of the Compounds of Gold.—P. Schottländer.—The author has studied the crystalline water of hydrochlorate of gold chloride, the action of silver carbonate upon the above-mentioned compound, certain reactions of potassium gold bromide, the action of manganese acetate upon neutral gold chloride, gold monoxide hydrate, gold trioxide hydrate, auryl-hydrate, the compounds of gold trioxide with nitric acid, and the sulphuric compounds of gold. In conclusion the author maintains that gold in the monoxide and its derivatives should be regarded as a bivalent element.

A New Product of the Slow Combustion of Ethyl-ether.—L. Legler.—Amongst the products of the slow combustion of ether, the author, in addition to formic and acetic acids, aldehyd, acetal, and methyl-aldehyd, has obtained a compound, $C_{11}H_{33}O_{21}$, with the examination of which he is still engaged.

Vol. 218, Part 1.

The Foundations of Thermo-Chemistry.—Lothar Meyer.—This paper will be inserted in full.

Communications from the Chemical Laboratory of the University of Jena.—These consist of a paper by Dr. A. Geuther, assisted by Dr. H. Laatsch and Dr. A. Bauchmann, on the magnitudes of the affinities of carbon, and a memoir by Dr. W. Poetsch on the action of carbon monoxide upon a mixture of sodium acetate and sodium iso-amylate.

The Phenyl-Esters of Phosphorous Acid.—Dr. E. Noack.—The author has obtained a series of compounds derived from a symmetrical phosphorous acid $P(OH)_3$ not yet known in the free state.

The Density and the Chemical Affinity of the Elements in Various Allotropic Conditions.—W. Müller-Erbach.—The author's researches extend to sulphur, selenium, phosphorus, carbon, silicon, boron, arsenic, and tin. Amongst these eight elements, which as solid bodies possess in different varieties different densities and affinities, it is questionable only in case of sulphur and silicon whether a higher degree of chemical affinity is not connected with a smaller specific gravity. In all other cases this connection is distinctly manifest, and in no case has there been a greater affinity observed along with a higher specific gravity. The behaviour of the so-called allotropic modifications of these elements furnishes new proof for the proposition that the activity of the chemical process is directly dependent on the possible lowering of the gravity of the reacting masses.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3e Série. Tome x., March, 1883.

This issue contains no chemical matter.

Cosmos Les Mondes.

Tome v., No. 1, May 5, 1883.

Liquefaction of Oxygen and Nitrogen. Solidification of Carbon Disulphide and Alcohol.—MM. Wroblewski and Olszewski.—Already noticed.

MISCELLANEOUS.

Hoffmann and Power's "Manual of Chemical Analysis."—In our review of this work (CHEMICAL NEWS, xlvii., p. 235) we omitted to mention that Messrs. J. and A. Churchill, 11, New Burlington Street, London, are the publishers of the work in this country.

Lea Conservancy Board.—The appointment of Consulting Chemist to the Lea Conservancy Board, vacant since the death of Mr. T. W. Keates, has been offered to and accepted by Mr. W. C. Young, F.I.C., F.C.S., Public Analyst for the Districts of Poplar and Whitechapel.

Use of Dehydrated Oxalic Acid for Preparing Normal Acidimetric Liquids and Standard Permanent Solutions.—Professor W. Hampe prepares this compound as follows:—Crystalline oxalic acid is dried at 100° , stirring carefully. It is then thrown by small portions into a platinum capsule heated on the sand-bath. Immediately above this capsule is fixed a precipitating vessel of Bohemian glass, perforated, and fitted with a paper bottom on the side turned towards the capsule; the paper is pierced with small pin-holes, so that a slow current of hot air passes through this diaphragm and the slit in the glass. There are soon formed long silky needles of sublimed oxalic acid which are collected by means of a feather, and kept under a bell-glass over sulphuric acid. For use, about 1 grm. of these crystals is weighed out in a stoppered tube and dried at 100° . If the acid has been kept for a sufficient length of time under the exsiccator its weight does not vary. Otherwise a few hours' exposure in a drying stove suffices to expel the traces of moisture absorbed. In all cases oxalic acid when once dry may be kept for hours at 100° without the slightest loss of weight.—*Monit. Scient.*

MEETINGS FOR THE WEEK.

- MONDAY, 4th.—Royal Institution, 5. General Monthly Meeting.
Society of Chemical Industry, 8. "The Packing of Goods of Delicate Odour, such as Tea, &c.," by G. W. Wigner, F.C.S. "On the Salt Deposits of the Cleveland District," by G. Ward, F.C.S.
- TUESDAY, 5th.—Royal Institution, 3. "Physiological Discovery," by Prof. McKendrick.
- WEDNESDAY, 6th.—Geological, 8.
- THURSDAY, 7th.—Royal Institution, 3. "Recent Discoveries in Cyprus and Asia Minor," by Mr. R. S. Poole.
Royal, 4.30.
Chemical, 8. Ballot for the election of Fellows. "Laboratory Notes," by Dr. J. H. Gladstone and Alfred Tribe. "On Evaporation in vacuo," by Prof. H. McLeod. "On a Basic Ammonio-Copper Sulphate," by Mr. Spencer U. Pickering.
- FRIDAY, 8th.—Royal Institution, 8. "The Electric Arc and Chemical Synthesis," by Prof. Dewar.
Astronomical, 8.
Quekett Club, 8.
- SATURDAY, 9th.—Royal Institution, 3. "Russian Social Life," by Prof. Turner.
Physical, 3. "Improved Construction of the Movable Ring Galvanometer Adopted for Measuring both Strength of Current and Difference of Potential," by Dr. E. Obach.

PATENTS.

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THE CHEMICAL NEWS.

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THE ROYAL SOCIETY.

THE BAKERIAN LECTURE.

ON RADIANT MATTER SPECTROSCOPY: A NEW METHOD OF SPECTRUM ANALYSIS.*

By WILLIAM CROOKES, F.R.S.

For several years I have been examining the phenomena presented by various substances when struck by the molecular discharge from the negative pole in a highly exhausted tube. I have ventured to call this discharge "radiant matter," and under its influence a large number of substances emit phosphorescent light, some faintly and others with great intensity. On examining the emitted light in the spectroscopic most bodies give a faint continuous spectrum, with a more or less decided concentration in one part of the spectrum, the superficial colour of the phosphorescing substance being governed by this preponderating emission in one or other part of the spectrum. Sometimes, but more rarely, the spectrum of the phosphorescent light is discontinuous, and it is to bodies manifesting this phenomenon that my attention has been specially directed.

For a long time past I have been haunted by a bright citron-coloured band or line appearing in these phosphorescent spectra, sometimes as a sharp line, at others as a broader nebulous band, but having always a characteristic appearance and occurring uniformly in the same spot. The best way to bring out the band is to treat the substance under examination with strong sulphuric acid, drive off excess of acid by heat, and finally to raise the temperature to redness. The anhydrous sulphate thus left frequently shows the citron band in the radiant matter tube, when before this treatment the original substance shows nothing. I soon came to the conclusion that the substance I was in search of was an earth, but on attempting to determine its chemical properties I was baffled.

Much chemical evidence tended to support the view that the band might be due to a compound of lime. By neglecting the portion showing least citron band, and separating all the elements present which gave little or none, I could generally concentrate the citron band into a solution which—according to our present knowledge of analytical chemistry—should contain little else than the earths, alkaline earths, and alkalis. Ammonia added to this solution would precipitate an earth, and in the filtrate oxalic acid would precipitate an insoluble oxalate, showing the citron band strongly. This was found on analysis to consist of strontic and calcic oxalates. The strontia being separated, the remaining lime formed an oxalate which gave the citron band.

So far all the chemical evidence went to show that the band-forming substance was calcium, and further tests tried with the purified oxalate confirmed this inference. Every analytical test to which it was subjected showed lime, and nothing but lime; all the salts which were prepared from it resembled those of lime, both physically and chemically; the flame spectrum gave the calcium lines with extraordinary purity and brilliancy; and, finally, the atomic weight, taken with great care, came out almost the same as that for calcium, 39.9 as against Ca 40.

On further examination it was found that most native compounds of lime gave the citron band. It was found in clear and colourless Iceland spar, native calcic phosphate, a crystal of arragonite, a stalactite of calcic carbonate from Gibraltar, cinnamon stone (lime alumina garnet), iron slag from a blast-furnace, pink coral, commercial plaster of Paris, and most specimens of ordinary burnt lime.

Evidence stronger than this in favour of the view that the citron band was an inherent characteristic of calcium could scarcely be; but, on the other hand, there was evidence equally conclusive that the band was not essential to calcium.

Starting with a lime compound which showed the citron band, I could always obtain a calcic oxalate which gave the band stronger than the original substance; but if I started with a lime compound which originally gave no citron band, I could never by any means, chemical or physical, constrain the lime or the earthy precipitate to yield a citron band.

The only explanation that I could see for this anomaly was that the elusive citron band was caused by some element precipitated with the calcic oxalate, but present in a quantity too small to be detected by ordinary chemical means. The calcic oxalate was ignited and dissolved in hydrochloric acid, and fractionally precipitated in three portions with ammonic oxalate, the first and third portions being comparatively small. They were then tested in the radiant matter tube. All three portions showed the citron band, but the portion which came down first gave the band decidedly the strongest, and the third portion precipitated showed it weakest.

It having been found that the substance giving the citron band formed a sulphate more soluble in water than calcic sulphate, four pounds weight of commercial plaster of Paris, which showed very faint traces of the citron band, were mixed with water and poured on a large filter. A few ounces of water were poured on, and after passing through, poured back, and the exhaustion repeated several times. The aqueous extract was then evaporated to dryness, ignited with sulphuric acid, ground in a mortar with small successive quantities of water, and precipitated with ammonic oxalate. The precipitate, ignited with sulphuric acid, showed the citron band very fairly, far more intensely than it was seen in the original calcic sulphate.

These experiments are conclusive in proving that the citron band is not due to calcium, but to some other element, probably one of the earthy metals, occurring in very minute quantities but widely distributed along with calcium, and I at once commenced experiments to find a more abundant supply of the body sought for. Amongst other substances tested I may note the following as giving a more or less decided citron band in the spectrum when treated with sulphuric acid in the manner indicated above:—Crystallised barytic chlorate, heavy spar, common limestone, strontic nitrate, native strontic carbonate, crystallised uranic nitrate, commercial magnesian sulphate, commercial potassic sulphate, tobacco ash, Wagnerite (magnesian phosphate and fluoride), zircon, cerite, and commercial ceric oxalate.

Some specimens of zircon appeared sufficiently rich to make it probable that here might be found an available source of the citron-band yielding body. I found it in crystals from Green River, North Carolina, from Ceylon, from Expailly, from Miask (Oural), and from Brevig, and having a good supply of North Carolina zircons, these were worked up by a process given in detail in the paper.

I may condense a year's work on zircon,—over ten lbs. weight of crystals from North Carolina having been worked up—by stating that the result was comprised in about 300 grains of an earthy residue, and about two ozs. of oxalate, chiefly calcic; the former gave the citron band very well.

The zirconia prepared from these zircons, when tested, sometimes showed the citron band, and at other times none. A zirconia rich in citron band, fractionally precipi-

* Abstract of the Bakerian Lecture delivered before the Royal Society, May 31st, 1883.

tated by ammonia, yielded precipitates of increasing richness, the last fraction showing the citron band strongly.

The calcic oxalate obtained from zircon gave unsatisfactory results, so attention was directed to the earthy residue. This was found to be of highly complex character, containing thoria, ceria, lanthana, didymia, yttria, and probably some of the newly-discovered rarer earths.

The position of the citron band in the spectrum falls exactly on the strongest absorption band of didymium, so that a piece of didymium glass or cell of solution of the nitrate entirely obliterates the citron band. This naturally suggested that the band was due to didymium.

Cerite was accordingly the next mineral experimented on. The powdered mineral tested in the tube in the original way gave a good citron band. The mixed earths after extraction were converted into sulphates, dissolved in water, and the cerium metals precipitated by long digestion with excess of potassic sulphate.

The precipitated double sulphates were converted into oxalates, and after ignition and treatment with sulphuric acid, the mixed ceria, lanthana, and didymia were tested in the radiant matter tube, but the merest trace only of citron band was visible.

This experiment proved the inadequacy of the didymium explanation, and further tests showed that not only could I get no citron band in pure didymium compounds, but the spectrum entirely failed to detect didymium in many solutions of the earth which gave the citron band brilliantly.

Attention was now turned to the solution filtered from the insoluble double sulphates. Potash was added, and the precipitate filtered off, and tested in a radiant matter tube. The spectrum, of extraordinary brilliancy, was far brighter than any I had hitherto obtained. Unfortunately, however, the quantity was too small to be subjected to very accurate chemical analysis.

Search was now made amongst other minerals rich in the rarer earths. Thorite was finely powdered, treated with sulphuric acid, and tested in the radiant matter tube. It gave the citron spectrum most brilliantly—equal in fact to the mixture of earths obtained from zircons at so great an expenditure of time and trouble. Orangite treated in the same manner gave almost as good a spectrum. Pure thorinic sulphate prepared by myself was found not to give the citron band, but three specimens prepared and given to me by friends all gave it, so it was not unlikely that in thorite and orangite might at last be found a good source of the long-sought element—that in fact the body I was hunting for, if not thorina, might possibly be Bahr's hypothetical Wasium. Two pounds of orangite and thorite were extracted with hydrochloric acid. The solution was precipitated with potassic sulphate, taking the usual precautions to secure complete precipitation. A bulky precipitate ensued, which contained the thorina and cerium earths. These were separated and tested, and found to give only a faint citron band.

The solution of earthy sulphates soluble in potassic sulphate was precipitated with ammonic oxalate. The precipitate ignited with sulphuric acid, and tested in a radiant matter tube, gave the citron spectrum with great brilliancy.

Certain chemical facts concerning the behaviour of the sought-for element which came out during the course of the tentative trials described in the paper considerably narrowed the list amongst which it might probably be found. All the evidence tends to show that it belongs to the group of earthy metals, consisting of aluminium, beryllium, thorium, zirconium, cerium, lanthana, didymium, and the yttrium family, together with titanium, tantalum, and niobium. The sought-for earth is insoluble in excess of potash; this excludes aluminium and beryllium. It is not precipitated by continued boiling with sodic thiosulphate; this excludes aluminium, thorium, and zirconium. Fused with acid potassic sulphate, the resulting compound is readily soluble in cold water; this excludes tantalum and niobium. Evaporating to

dryness with hydrochloric acid and heating for some time does not render the mass insoluble in water; this excludes titanium and silicium. It is easily soluble in an excess of a saturated solution of potassic sulphate; this excludes thorium, the cerium group, some of the numerous members of the yttrium group, and zirconium. The only remaining elements among which this elusive body would probably be found are those members of the yttrium family which are not precipitated by potassic sulphate.

The yttria earths form a somewhat numerous family. Fortunately for chemists, a mineral rich in yttria earths—samarskite—has been found lately in large quantity in Mitchell County, North Carolina, and to this mineral I accordingly now directed my attention.

The following list of elements of the yttrium and its allied families said to occur in samarskite and similar minerals may be considered complete to the present time.

Name.	Absorption Spectrum.	Hydrogen equivalent of Metal.* (Type of Oxide M ₂ O.)
Cerium	No	47.1
Decipium	Yes	57.0
Didymium	Yes	48.5
Didymium β	Yes	47.0
Erbium	Yes	55.3
Holmium	Yes	54.0
Lanthanum	No	46.0
Mosandrum	No	51.2
Samarium	Yes	50.0
Scandium	No	14.7
Terbium	No	49.5
Thulium	Yes	56.5
Ytterbium	No	57.9
Yttrium	No	29.7
Yttrium α	No	52.2
Yttrium β	Yes	49.7

Some of these claimants it is certain will not stand the test of further scrutiny. Thus samarium and yttrium β are in all probability identical; and I have not included philippium, as Roscoe has conclusively proved that this is a mixture of terbium and yttrium, and my own results confirm those of Roscoe. Moreover, some of these so-called elements will probably turn out to be mixtures of other known elements. But in the confessedly very imperfect state of our knowledge of the chemistry of these metals it is not safe for me in this research to assume that any one of them will surely not survive. The complete list as it stands will therefore be taken to contain all hitherto claimed as new, although it is almost certain to include too many.

In the second column "Yes" or "No" indicates whether the solutions give an absorption spectrum when examined by transmitted light. After numerous experiments I satisfied myself that the metal giving the citron band spectrum was not one of those giving an absorption spectrum. The possible elements, therefore, became narrowed to the following list:—Cerium, lanthanum, mosandrum, scandium, terbium, thorium, ytterbium, yttrium, yttrium α and zirconium.

Of these the potassic sulphate reaction excludes cerium, lanthanum, scandium, thorium, yttrium α, and zirconium, so there are left only the following:—

Mosandrum,
Terbium,
Ytterbium,
Yttrium.

Certain chemical reactions for a long time made me dismiss yttrium from the list of likely bodies. In my

* As it is at present doubtful whether the oxides of several of the metals in this Table belong to the type M₂O, M₂O₃, or MO, I have, for the sake of uniformity and simplicity in calculating the values from the composition of their salts, by which these metals are chiefly discriminated, taken the type of oxide to be M₂O.

analysis of zircons, towards the latter part of the process, I used the following process to separate the iron:—The solution mixed with tartaric acid and excess of ammonia was allowed to stand for some time. A small quantity of a precipitate gradually formed, which was filtered off, and it was this filtrate, after separating the iron with ammoniac sulphide, that yielded the greatest quantity of substance giving the citron band. Now one of the methods of separating yttria from alumina, berylla, thoria, and zirconia is to precipitate it as tartrate in the presence of excess of ammonia, the other earths remaining in solution. Fresenius says:—"The precipitation ensues only after some time, but it is complete."

The precipitate thus obtained with tartaric acid and ammonia should therefore contain all the yttria: *it gave no citron band whatever in the radiant matter tube*; whilst the residue, which should be free from yttria, proved for a long time the only source of material wherewith to investigate the chemical properties of the body giving the citron spectrum.

Another reason which made me, at this stage of the research, pass over yttria, was that I had already tested this earth in the radiant matter tube. In a paper on "Discontinuous Phosphorescent Spectra in High Vacua," read before the Royal Society, May 19th, 1881, I said—"Yttria shows a dull greenish light giving a continuous spectrum."

For these reasons I for a long time omitted yttria from my list of possible bodies, and considered that the earth, if not a new one, might turn out to be either mosandra, terbia, or ytterbia.

About 15 lbs. weight of samarskite was worked up, partly by the hydrofluoric acid method of Lawrence Smith, and partly by fusion with potassic bisulphate.

These methods both gave as a result a large quantity of mixed earths containing most, if not all, the bodies enumerated in the foregoing list. Tested in the radiant matter tube this mixture gave the citron spectrum very brilliantly.

These earths were treated by a series of chemical processes too long and complicated to describe in this abstract, and the result of about five hundred fractional precipitations gave me a mixture of earths having an H equivalent, $M=48$, and showing a strong absorption spectrum; a mixture having an H equivalent, $M=33$, having no absorption spectrum; and intermediate earths.

In the radiant matter tube all these fractions gave the citron band spectrum well, but that of the earth of lowest equivalent was much the brightest, and that of the highest equivalent the least intense.

Three methods are available for the partial separation of these earths and for the complete purification of any one of them. The formic acid process is best for separating terbia, as terbic formate is difficultly soluble in water, the other formates being easily soluble.

Fractional precipitation with oxalic acid separates first erbia, holmia, and thulia, then terbia, and lastly yttria. This is the only method which is applicable for the separation of small quantities of terbia from yttria.

Fusing the nitrates separates ytterbia, erbia, holmia, and thulia from yttria. It is not so applicable when terbia is present, and is most useful in purifying the gadolinite earths. This process is the only one known for separating ytterbia from yttria.

Selection must be made of these methods according to the mixture of earths under treatment, changing the method as one earth or the other becomes concentrated on one side or thrown out on the other. Each operation must be repeated many times before even approximate purity is attained. The operations are more analogous to the separation of members of homologous series of hydrocarbons by fractional distillation than to the separations in mineral chemistry as ordinarily adopted in the laboratory.

Pure terbia ignited with sulphuric acid and tested in the radiant matter tube shows no citron band spectrum.

A concentrated solution of the purest terbia obtained in this way, when examined by the spectroscopy, showed no absorption lines whatever: proving the absence of erbium, holmium, and thulium.

I did not attempt any separation of erbium, holmium, and thulium from each other, as the evidence obtained was sufficient to show that the element giving the citron band spectrum was not one of these three metals. Likewise I had far too little material to enable me to enter on a work of such difficulty with any prospect of success.

The chemical characters of mosandra are so little known that I could not attempt to search for it. But as the citron band-forming earth always appeared concentrated amongst those whose double sulphates were most soluble in potassic sulphate,—and, of these, amongst those having the palest colour and lowest atomic weight,—it was scarcely conceivable that the earth I was in search of should ultimately prove to be one whose properties did not in any case correspond to these,—of a dark orange yellow colour, forming a difficultly soluble double potassic sulphate, and having the very high equivalent of $M=51.2$; these being the properties ascribed to mosandra by the discoverer, Professor Lawrence Smith.

Ytterbia was prepared from gadolinite, as this mineral is said by Nilson to contain most ytterbia. It was separated from accompanying earths by processes described in the paper. The resulting earth gave at first a faint citron band spectrum, evidently due to impurity; on repeating the purification several times I at last succeeded in obtaining a white earth which gave only the merest trace of citron band spectrum. Its hydrogen equivalent, 58.0, and its chemical properties showed that it was probably Marignac's ytterbia. Subsequent experiments satisfied me that this earth did not contain more than 1-10,000th part of yttria. The extreme tediousness of the chemical operations necessary to obtain this high degree of purity, and the long time they required, prevented me from pushing these results beyond what was necessary to prove the special point at issue.

The yttria, purified as already described, might still contain traces of terbia, together with erbia, holmia, and thulia. These were gradually removed by the fusing nitrate process. The atomic weight gradually got down to 31.0, but the spectra did not vary very much; that from the earth of lowest atomic weight being, however, the most brilliant.

Pure yttria is quite white. That from gadolinite on testing in the radiant matter tube gave a spectrum absolutely identical with that given by the zircon, cerite, thorite, orangite, and samarskite yttria. Pure yttria was also prepared from ytthro-tantalite, euxenite, tyrite, and also from plaster of Paris and common limestone. In no case could I detect any difference in the position or intensity of the lines shown by their phosphorescent spectra.

The Phosphorescent Spectrum of Yttria.

The spectrum shown by pure ignited yttric sulphate in a radiant matter tube is one of the most beautiful objects in the whole range of spectroscopy. The spectrum is best seen under low dispersion and not too narrow a slit. It consists essentially of a broad red band, an intensely brilliant citron band, and two almost equally brilliant green bands. Other fainter lines are also seen, but they are not characteristic. Coloured drawings and maps of the spectrum to scale accompany the paper. This description applies to the spectrum shown either by pure yttric sulphate or by an earth tolerably rich in yttria. When traces are present the citron band only is seen. A little more yttria brings out the first and then the second green band, and finally, as the proportion of yttria increases, the red and blue bands appear.

The paper next gives a description of experiments made with pure yttria, and with various compounds of it, to see which would give the most characteristic spectrum. The sulphate heated to redness was found to give the best re-

sults. Pure yttria precipitated by ammonia did not phosphoresce in the slightest degree, and, necessarily, no citron band spectrum was to be seen. The yttria was removed from the tube, converted into sulphate, heated to redness, and again tested. This time it gave the citron band magnificently. This shows what apparently trivial circumstances will alter the whole course of an investigation. In 1881, when searching for discontinuous phosphorescent spectra, I tried a similar experiment with pure precipitated yttria, and entirely missed its citron band spectrum. Had I first treated the yttria with sulphuric acid instead of testing the earth itself in the radiant matter tube the results would have been very different, and this research would probably have never been undertaken.

Yttria was now prepared by igniting the precipitated oxalate at a red heat. On testing it in the radiant matter tube it phosphoresced with feeble intensity, the light being about one-twentieth of that given by the ignited sulphate under similar conditions. The citron band was almost as sharp as the sodium line, and was shifted one division towards the blue end. The two green bands were visible, but very hazy and indistinct, and only to be resolved into bands with difficulty.

It is an old and probably a true saying that every element could be detected everywhere had we sufficiently delicate tests for it. Early observations had prepared me for the wide distribution of yttrium, and no sooner had the exquisite sensitiveness of this spectrum test forced itself on my notice than I sought for yttrium in other minerals. The facts which I had noticed in connection with the variation of the appearance of the citron spectrum, according to the quantity of yttrium present, showed that it might be possible to devise a process for the rough quantitative estimation of yttrium, and after several experiments a spectrum test was devised sufficiently delicate to detect one-millionth part of yttria in a mineral. A table is given showing the results of this quantitative spectrum analysis, from which it is seen that amongst other substances pink coral contains one part of yttrium in 200 parts; strontianite, one part of yttrium in 500 parts; chondrodite, from Mount Somma, one part in 4,000; calcite, one part in 10,000; ox bone, one part in 10,000; an earthy meteorite (Alfianello), one part in 100,000; and tobacco ash, one part in 1,000,000.

THE FOUNDATIONS OF THERMO-CHEMISTRY.

By LOTHAR MEYER.

THE author shows at some length that notwithstanding the great number of thermo-chemical determinations, and the trustworthiness of a not inconsiderable portion of the constants thence deduced, little can be perceived of a homogeneous, coherent theory of chemical transformations based upon a thermo-chemical foundation. Attempts in this direction have met with doubt, if not with opposition. Though entire series of observations seem to be subordinate to the universally recognised principles of the thermic theory, others appear, often in great numbers, so contradictory that they cannot be brought into harmony even by the acutest interpretation.

The cause of this disagreement is to be sought in an improper application of the doctrines of the mechanical heat theory. Here, in fact, according to my apprehension, lies the entire cause of the present uncertain and unsatisfactory condition of the chemical theory of heat. We torment ourselves with worn-out hypotheses and theoretical conceptions which have long ago been thrown aside by the physicists, and we wonder that phenomena do not take place as we predicted in accordance with these dogmas.

The first, but not the most dangerous, of such dogmas is the assumption that the atoms are particles of masses

endowed with attraction acting through space. Yet it is very possible, even if not highly probable, that everything which we call attraction is produced by certain movements of small molecules, by impact or pressure. If this holds good also concerning affinity, its satisfaction consists not in a transformation of potential into kinetic energy, but both combination and decomposition are simply conversions of one form of kinetic energy into another. The difference in the manner of interpreting phenomena is not very great, but it throws a doubt on the far-reaching conclusions which have been drawn from the proposition that decomposition necessarily involves the production of potential energy, whilst combination is a transfer of potential energy into kinetic.

But even if we retain the accepted, though unproved, hypothesis on the nature of affinity, we find in the views which are explicitly or tacitly used as the foundation of thermo-chemical speculations, many an untenable conception, and many a dogma based thereon. Without their removal thermo-chemistry will never arrive at clearness.

Though no one will now seriously maintain that the chemical atoms are particles of matter *at rest*, yet the thermo-chemical doctrines which have been latterly most strongly emphasized, proceed from this assumption, and stand thus on a foundation which their authors do not admit as correct. This applies especially to the proposition which has been more or less distinctly announced in different forms, that in the absence of disturbing collateral action, chemical transformation always takes place according to those affinities which in their saturation produce the greatest heat.

If we conceive the atoms as *particles of matter at rest*, whose mutual attractions (affinities) decrease with increasing distance, according to any law, but certainly very rapidly, then two atoms, A and B, on being so nearly approximated to each other that the attractions come into play, will move towards each other, and on contact their potential energy will be entirely transformed into kinetic energy, which may partially or entirely assume the form of heat. If a third atom, C, comes near, whose affinity for A exceeds that of B, still no transformation takes place so long as the attraction between A and C, on account of the greater distance, is smaller than that between A and B. Not until it has been brought by any cause sufficiently near will it combine with A and drive out B. The kinetic energy (heat) thus arising is equivalent to the potential energy which existed between A and C, less the amount of work expended in separating A and B. Any decomposition of the compound AC by B is completely excluded, and therewith any chemical transformation involving the consumption of heat.

But the conception upon which this view is based does not in the least correspond to the real behaviour of the chemical elements and of their compounds. The atoms and molecules are particles of matter not at rest, but in very brisk movement. Each molecule is not merely in motion as a whole, but its individual parts—the atoms of which it is composed—have also especial movements, which are, however, limited so far that none of them can remove to any distance from the other atoms of the molecule.

The form and the strength of these movements depend, in addition to the nature of the matter, primarily upon the temperature, and very often upon the space which is offered to a given quantity of matter. Concerning the form of the molecular movements, especially of gases, we can make some moderately certain assertions. What forms the atomic movements the atoms have within the molecule is substantially quite unknown. But we may maintain that they are either of such a nature that their *vis viva* remains always equal, or that it alternately decreases and increases at the expense of so-called tension or potential energy. The first case would, *e.g.*, occur if an atom revolved on itself, or if several atoms described circular tracks round each other, or round some common

centre of gravity. The second case would occur if the orbits were elliptical, or if the atoms moved to and fro. Movements of this second kind are the most probable by which the mutually attracting atoms alternately approach and recede from each other. If the movements of the atoms in the molecule are of this kind its decomposability will be sometimes smaller, sometimes greater, according to the relative positions which the atoms occupy at the moment. It is therefore quite possible that one and the same substance may be decomposed in one case, and not in another, by the action of one and the same substance, without our being able to distinguish a difference in the external conditions, especially in the temperature.

For the decomposition of a compound A B, by an atom C, it is not even necessary that in any position the attraction between A and B should be smaller than that between A and C. On the contact of the violently moving particles the most various results may ensue. One possible case is that whilst A and B are at their greatest distance from each other, C impinges upon A with great velocity, driving it quite out of the sphere of action of B, and combining with it. A part of the *vis viva* of C is thus consumed in overcoming the affinity of A for B, whilst again heat, or some other form of kinetic energy, is produced from the affinity of A for C. Whether after the transformation the kinetic energy of the whole system formed of these atoms is greater or less than before, depends on whether C or B has the greater affinity for A. But for the occurrence of the transformation it is evidently not necessary that B should have the greater (less?), since C may make up in *vis viva* what is wanting in affinity. The temperature after the change will be lower, but this does not render the process impossible.

Of course just as A B is decomposed by C, inversely A B may be re-constituted from A C and B. We might even be tempted to believe that by reason of the greater affinity this re-constitution must be easier, and must therefore occur more frequently than the decomposition, so that each quantity of the compound A C formed would be again decomposed, and finally the transformation involving the greatest action of heat would gain the upper-hand. This assumption is by no means necessary, as the possibility and the ease of a chemical union depend not merely on the strength of the affinities, but also on other properties of the atoms and compounds, and on external circumstances. For combination it is not enough that the particles should come in contact, but it may essentially depend upon the kind of the contact. If, *e.g.*, C can combine with A in every position, but B only when A approaches it from a certain side, as will be the rule with compound radicles, A C will be more readily formed than A B, and every A which becomes isolated on collision will soon find a B with which it combines, whilst it may meet perhaps a hundred times with a B before the compound A B can be re-constituted.

Accordingly we see that many chemical transformations are accompanied by their exact opposites; a heat-liberating and a heat-absorbing process may go on side by side under identical external conditions.

It is usual here, in order to save the dogma, to maintain that the one process is due to the action of affinity, and the inverse one to that of heat, consequently to an external cause. This is, however, little better than a play with words, since certainly very few chemical transformations—probably none at all—take place without heat. But if heat is concerned in both the above-mentioned processes, it is arbitrary to say that the one ensues by affinity, with the aid of heat, and the other by heat, aided by a feebler affinity. If we call the heat which the mutually reacting bodies possess as molecular or atomic motion, a foreign energy, there is perhaps no chemical change which is effected without the aid of such foreign energy; certainly it could only be observed at the absolute zero, -273° .

The difference between the chemical transformations taking place with liberation and with absorption of heat

is not principal. As far as the chemical changes of matter are accessible to our observation, they take place under the influence of light, of heat, of electricity, and of other forms of kinetic energy. Scarcely anywhere is the union of two atoms dissolved without their own kinetic energy taking part in the work performed in overcoming their affinities. The loss thus arising is generally covered by the heat evolved from the newly-combining affinities, so that the final result is the same as if the entire work of dissolving the former combination had been effected by them alone. Nevertheless we are not at once entitled to place this work entirely to the account of what has been consumed; the case is not rare when this would not be correct even for a part of the work. Supposing a compound A B decomposed by the action of a high degree of heat communicated to it; let the atom A, thus liberated, meet with a third atom, C, and unite with it; the heat-relation of the entire process is exactly the same as if the compound A B had been decomposed by the affinity of C for A. Yet in reality two processes have taken place, having no further connection than that the one furnishes the material for the other.

Neither theoretical considerations nor observations compel the assumption of a principal difference in the transformations accompanied by liberation and with absorption of heat. Such an assumption would, on the contrary, throw out of connection a number of closely-connected facts,—*e.g.*, the decompositions of salts and analogous compounds by acids or bases which are accompanied by a rise or a fall of temperature, not merely according to the nature of the substances, but according to the quantities which act upon each other.

Recent investigations on the action of masses have shown very plainly that many, if not most, chemical changes are accompanied by their exact opposites, so that there never occurs a state of rest without change, but a condition of equilibrium in which the transformation effects exactly as much in one direction as it destroys in the opposite. Hence an absorption of heat constantly compensates an equivalent liberation of heat. It cannot, therefore, be said that transformation takes place only in the direction of the heat-producing affinities. In very many cases the reaction attended with absorption of heat greatly predominates, so that an acid possessing a small neutralisation heat takes away the greater part of the base from another acid with a greater neutralisation heat, the process being attended with the production of cold.

Concerning a part of these changes, especially the neutralisation of acids and bases, we know—what probably holds good of many other transformations—that the accompanying thermic changes, as well as certain other physical processes, such as the changes in volume and in the refraction of light, depend *not on the mutual relations of the combining bodies,—i.e., on their respective affinities,—but on the nature of each taken individually.* The changes in heat, in volume, in the refraction of light, consists always of two parts, the one depending only on the nature of the acid and the other on that of the base. The neutralisation of an acid with potassa always produces a certain number of calories more, and an expansion to a certain greater extent, than neutralisation with ammonia, whatever may be the nature of the acid. The neutralisation of a base with sulphuric acid always evolves a constant number of calories greater than appears on neutralisation with hydrochloric or nitric acid, whatever may be the base concerned. If therefore the neutralisation-heat of one base with all acids, and of one acid with all bases, is known, that of any conceivable combination of acids and bases may be easily calculated. The neutralisation-heat is just as little dependent on the strength of the neutralised affinities as are the equivalent weights; it is merely the consequence of a change of condition brought about by affinity. The neutralisation-heat proper to the substance in question is set at liberty as soon as neutralisation takes place, by whatever it is produced. Affinity effects merely the liberation of the available energy, just

as a tiny spark or an entire firebrand causes a cask of powder to explode with equal strength.

What holds good for neutralisation applies probably also to many other reversible processes; whether it extends to such as are not reversible cannot yet be determined. Certain classes of these phenomena, such as the precipitation of the metals, including hydrogen, by each other, the replacement of one haloid by another, and many other transformations occur, commonly, though not always, with liberation of heat. Still, it remains doubtful whether the connection between the quantity of heat liberated and the strength of the affinities is so direct as is commonly assumed; whether, in other words, the heat evolved is a correct gauge of the strength of the affinities satisfied, and the heat absorbed a measurement of the strength of the affinities dissolved.

If the metals are arranged in a series so that each is precipitated from its solutions by the next following, we obtain, with few exceptions, the same classification as if they were arranged according to the thermic changes which accompany their solution. The series is also essentially identical with the series of electric tension which contains the metals arranged according to the electromotive powers which each two of them are able to produce with the proper solvent. But for this very electromotive power proof has been recently given that its alleged proportionality with the quantity of heat produced by the chemical change occurring in the current does not hold good, the electromotive power being sometimes smaller, sometimes greater, than it ought to be according to the erroneous doctrine of the equivalence of the electromotive power to the chemical transformation of the current. It has been shown that only a part of the energy liberated in this transformation and designated "free energy," is available for the production of the current or for other duties, whilst another portion, known as "combined energy," is not thus available. It may be foreseen that also as regards other results of the energy contained in the chemical elements and compounds, including pure chemical actions, a separation into these two parts will be needful before the laws of its transformations and of its relations to what we call affinity can become manifest to us. Nothing but the long road of laborious research, experimental and theoretical, will conduct us thither. On our way the masses of thermo-chemical observations already accumulated will doubtless arrive at very great importance for the clear insight into the nature of chemical processes. Present theoretical considerations, however, are not yet equal to the right utilisation of the accumulated materials, and they seek for the solution of the difficult problem in too simple a manner. It is possible, and even probable, that when once the true solution has been found, the hypothesis of affinity as an attractive force will disappear, and in its place will come an insight into the nature of matter of which we can as yet scarcely dream.—*Liebig's Annalen*.

A NOTE UPON THE WORKING OF SULPHURIC ACID CHAMBERS.*

By HENRY PEMBERTON, Jun.

DURING several years subsequent to the panic of 1873 a set of acid chambers, the property of a company of this city, was worked under my supervision. Owing to the depressed state of trade, and consequent stock of goods on hand, the chambers were often run below their full capacity. They were run without a Gay-Lussac absorbing tower, and burned best unimixed seconds brimstone, 4000 pounds being the normal charge in twenty-four hours. Good results, approaching very nearly to the theoretical

figures, were obtained from such a charge when 10 p. ct. nitre was used. Burning 3600 pounds per day, 9 per cent nitre was required, and with 3000 pounds, 8 per cent. As the cubic capacity of the set was 107,200 cubic feet, the following represents the pounds sulphur, per cent nitre, and cubic feet per pound sulphur:—

Pounds Sulphur.	Per cent Nitre.	Cubic ft. per pound Sulphur.
4000	10	= 26·8
3600	9	= 29·8
3000	8	= 35·7

Several years after this the capacity was nearly doubled by the addition of two more chambers, the whole being run in one set, with a Gay-Lussac and Glover—still burning brimstone. The total number of cubic feet was now 202,600, the towers and connecting pipes not being included. Sulphur charged was about 10,500 pounds a day, per cent nitre from 3 to 3½.

The following gives the totals of four weeks running (28 days), being a fair illustration of the working of the chambers when in good condition:—

Total sulphur burned	295,265 lbs.
„ nitre potted	10,005 „
No. of blow-ups of nitrous acid run through the Glover	325 „

Dividing these figures by 28, we get as the daily average:—

Sulphur burned	10,545 lbs.
Nitre potted	357 „
Blow-ups of nitrous vitriol through the Glover	11·61 lbs.

The test of this nitrous vitriol was made with permanganate, using 5 c.c. of solution, containing 15·8 grms. KMnO_4 per litre (=½ normal).

The nitrous vitriol was run into this from a graduated pipette, the volume required varying from 1·2 to 1·5 c.c. Adding up the total tests made in the above 28 days, I find that as a daily average 1·352 c.c. nitrous vitriol exactly decolourised the 5 c.c. of permanganate. It results from this that 100 pounds nitrous vitriol contains N_2O_3 equivalent to 4·62 pounds of chemically pure nitrate of soda. 11·61 blow-ups of this went daily through the Glover, each blow-up delivering 2334 pounds 1·7 specific gravity acid. Hence, total nitrous vitriol = 27,097 pounds at 4·62 per cent = 1252 pounds pure NaNO_3 = 1291 commercial 97 per cent nitrate.*

Hence the chambers were charged with nitre as follows:

From Glover	1291 lbs.
„ nitre pots	357 „
Total	1648 „

This 1648 pounds nitre = 15·62 per cent of the weight of the sulphur (10,545), and the chamber capacity (202,600 cubic feet) = 19·2 cubic feet per pound sulphur.

Combining this with results from old set of chambers, we have:—

Sulphur burned.	Per cent Nitre.	Cubic ft. per pound Sulphur.
4000	10	26·8
3600	9	29·8
3000	8	35·7
10,545	15·62	19·2

The above shows the proportion of the two variables, nitre and cubic feet per pound sulphur, under widely dif-

* A Paper read before the Chemical Section of the Franklin Institute, March 13, 1883.

* The acid after it had passed through the Glover was tested to see if it had any action on the KMnO_4 , with practically negative results, proving that the acid had been completely denitrated, and was free from foreign reducing substances.

ferent circumstances; for the nitre varied from 8 to over 15½ per cent, and the cubic feet from 35·7 to 19·2, the increase of one being proportionate to the decrease of the other.

This being the case, the product obtained by multiplying the two together should be nearly a constant quantity, as follows:—

$$\begin{array}{r} 10 \times 26\cdot8 = 268 \\ 9 \times 29\cdot8 = 268 \\ 8 \times 35\cdot7 = 285 \\ 15\cdot62 \times 19\cdot2 = 300 \\ \hline \text{Mean} = 280 \end{array}$$

To give an illustration of the meaning of figure 280: a chamber with 280 cubic feet capacity per pound sulphur would require 1 per cent nitre, one with 140 cubic feet would require 2 per cent, with 28 cubic feet 10 per cent, with 14 cubic feet 20 per cent, and so on.

It is not to be expected that any formula based upon such changeable data as are furnished by the gases of an acid chamber will give absolutely unvarying results. Changes of the seasons, of the barometer, of temperature, of the direction of the wind, of the steam pressure, and from a hundred local sources, cause the result to vary within certain limits. Although the figures given above are derived only from this one particular set of chambers, and although it would be very interesting to have corroborative proof from other experiences, nevertheless it must be remembered that the above trials extended over a number of years, and were made under very widely different circumstances. They were made when the capacity was only about 100,000 cubic feet, and again when it was double this, when the chambers were running without towers, and later when both Gay-Lussac and Glover were present. Therefore, since in all these cases the resulting figures were closely accordant, they may be accepted by any manufacturer as a check upon the working of his chambers.

The chamber capacity in cubic feet, multiplied by the per cent nitre used, and divided by the number of pounds of sulphur burned daily, should give a result not far from 280, and all the better if it approaches to 300. If the result falls considerably below the former figure it is a pretty safe indication towards a low yield in acid, and a consequent loss in money.

ON ALGIN: A NEW SUBSTANCE OBTAINED FROM SOME OF THE COMMONER SPECIES OF MARINE ALGÆ.*

By EDWARD C. C. STANFORD, F.C.S.

(Concluded from p. 257).

It is interesting to notice the way in which the salts come out, and analyses have been made with this view. The results are shown in the following tables:—Calcium sulphate and magnesium chloride are both present in the aqueous solution of the Laminaria and in the residue of the Fuci—carbonates generally in the salts of the Fuci and the residue of the Laminaria. In the latter, which is always submerged, the relation of the magnesium to the calcium is singularly like that existing in sea water.

Within certain limits the composition of the salts differ considerably, the age of the plant and the time of gathering both affecting it.

The following samples are from a considerable bulk of mixed salts evaporated:—

ANALYSES OF THE SALTS.

		Laminaria stenophylla.	Fucus vesiculosus.
Calcium sulphate	1·69	4·33	
Potassium sulphate	11·29	23·62	
Potassium chloride	19·90	13·71	
Sodium chloride	60·96	58·20	
Magnesium chloride	4·35	—	
Sodium carbonate	0·53	—	
Sodium iodide	1·26	0·12	
	99·98	99·98	

In the following tables the composition of the salts are shown as they come out in six successive macerations in cold water.

The residues are always carbonised, and then washed and again ignited—that being the only way to insure perfect combustion in the presence of such an excess of saline constituents.

Laminaria stenophylla—Air-dried.

Containing 14·8 Moisture.

4 ozs. = 1750 grains. Six macerations in cold water; all evaporated, and residues weighed.

	Grs.	P. c.	Grs.	P. c.
1st water-weight of residue	288	16·45	499	= 28·5
2nd " "	211	12·05		
3rd " "	40	2·28		
4th " "	37·2	2·12	77·2	= 4·4
5th " "	21·1	1·20		
6th " "	18·6	1·06		

615·9 = 35·16 per cent.

	1.	2.	3.	4.	5.	6.
Volatile matter	23·4	28·0	29·3	40·0	54·5	69·1
Salts	67·1	60·1	55·5	40·0	31·8	22·5
Fixed carbon ..	3·91	4·97	4·1	4·56	2·23	0·96
Ash	5·59	6·93	11·1	15·44	11·4	7·44
	100·0	100·0	100·0	100·0	100·0	100·0

Composition of Salts.

	1.	2.	3.	4.	5.	6.
Calcium sulph.	2·91	1·02	Nil.	Nil.	Nil.	Nil.
Potass. sulph.	7·53	10·08	19·48	20·80	trace	trace
Potass. chlor.	34·05	30·95	24·81	23·78	"	"
Sodium chlor.	45·55	53·00	53·57	51·04	"	"
Sodium iodide	1·95	1·58	2·00	1·25	"	"
Sodium carb.	Nil.	Nil.	trace	3·30	"	"
Magnes. chlor.	8·55	3·40	trace	trace	"	"
	100·54	100·03	99·86	100·17	"	"

Laminaria stenophylla—Air-dried.

Calculated Percentage on Original Weed.

	Per cent.	Volatile.	Salts.	Carbon.	Ash.
1st Water ..	16·45	3·85	11·04	0·64	0·92
2nd " ..	12·05	3·35	7·26	0·60	0·84
3rd " ..	2·28	0·68	1·26	0·09	0·25
4th " ..	2·12	0·86	0·85	0·09	0·32
5th " ..	1·20	0·656	0·38	0·027	0·137
6th " ..	1·06	0·732	0·24	0·010	0·078
	35·16	10·128	21·03	1·457	2·545

Composition of Salts.

	1.	2.	3.	4.	5.	6.	Total.
Calcium sulph.	0·321	0·074	Nil.	Nil.	Nil.	Nil.	0·395
Potass. sulph.	0·831	0·731	0·245	0·177	trace	trace	1·984
Potas. chloride	3·759	2·247	0·312	0·202	"	"	6·520
Sodium chlor.	4·970	3·846	0·678	0·432	"	"	9·926
Sodium iodide	0·215	0·115	0·025	0·011	"	"	0·366
Sodium carb.	Nil.	Nil.	trace	0·028	"	"	0·028
Magnes. chlor.	0·944	0·247	trace	trace	"	"	1·191
	11·040	7·260	1·260	0·850	0·38	0·24	21·030

* Read before the Chemical Section of the Glasgow Philosophical Society, April 2, 1888.

Laminaria stenophylla—Air-dried.

Residual weed—Weight 2 ozs., or 50 per cent.

		Calculated on original weed, per cent.
Volatile matter	74.2	37.1
Charcoal	25.8	12.9
	100.0	50.0
<i>Charcoal.</i>		
Salts	18.0	2.32
Fixed carbon	50.7	6.55
Ash	31.3	4.03
	100.0	12.90
<i>Salts.</i>		
Potassium sulphate ..	35.27	0.818
Potassium chloride ..	6.72	0.156
Potassium carbonate ..	5.00	0.116
Sodium carbonate ..	49.97	1.169
Sodium iodide ..	2.63	0.061
Alkaline earths ..	Nil.	Nil.
	99.49	2.320

Fucus vesiculosus—Dried.

Containing 2.11 per cent Moisture.

4 ozs. = 1750 grs. Six macerations in cold water—all evaporated, and residues weighed.

	Grs.	Per cent.
1st water weight of residue	174.5	= 9.45
2nd " "	43.0	= 2.45
3rd " "	11.2	0.64
4th " "	6.15	0.35
5th " "	trace	
6th " "	trace	
	234.85	= 12.89

	1.	2.	3.	4.
Volatile matter, &c. ..	37.78	68.4	47.48	62.86
Salts	49.03	27.62	29.22	25.71
Fixed carbon	8.09	1.17	3.78	0.74
Ash	5.10	2.81	19.52	10.69
	100.00	100.00	100.00	100.00

	1.	2.	3.	4.
Potassium sulphate ..	27.25	48.19	trace	trace
Sodium sulphate ..	4.03	0.57	"	"
Sodium chloride ..	61.50	37.62	"	"
Sodium iodide ..	0.026	0.02	"	"
Sodium carbonate ..	7.42	13.36	"	"
	100.226	99.76	"	"

**Fucus vesiculosus*—Dried.

Calculated on original Weed.

	Per cent.	Volatile.	Salts.	Carbon.	Ash.
1st Water ..	9.45	3.58	4.63	0.76	0.48
2nd " ..	2.45	1.68	0.67	0.03	0.07
3rd " ..	0.64	0.304	0.187	0.024	0.125
4th " ..	0.35	0.221	0.089	0.003	0.037
5th, trace ..	—	—	—	—	—
6th, trace ..	—	—	—	—	—
	12.890	5.785	5.576	0.817	0.712

* This specimen was abnormally low in salts

Composition of Salts.

	1.	2.	3.	4.	Total.
Potas. sulphate	1.262	0.343	trace	trace	1.605
Sodium "	0.186	0.004	"	"	0.190
Sodium chloride	2.8378	0.2337	"	"	3.0715
Sodium iodide	0.0012	0.00013	"	"	0.00133
Sodium carbnt.	0.343	0.0895	"	"	0.4325
	4.630	0.6700	0.187	0.089	5.576

Residual Weed—Fucus vesiculosus.

Weight, 3 ozs. 175 grains = 85 per cent.

	Calculated on original weed.
Volatile matter	65.65
Charcoal	34.35
	100.00
<i>Charcoal.</i>	
Salts	18.63
Fixed carbon	58.53
Ash	22.84
	100.00
<i>Salts.</i>	
Potassium sulphate ..	29.41
Sodium sulphate ..	47.58
Calcium sulphate ..	9.34
Magnesium sulphate ..	11.76
Magnesium chloride ..	1.30
Sodium carbonate ..	0.45
Sodium iodide ..	0.22
	100.06

After the salts have been removed, the weed is bleached by a weak solution of chlorinated lime, about 2° Tw. The *Laminaria* bleaches easily in a few hours, but the *Fucus* require prolonged and repeated treatment. I will call attention to the extreme beauty of some of the algae before you when thus bleached, even in the common *Fucus vesiculosus*, or black wrack; you can trace the spores in the cells and the lining of the air-vessels. The specimen of *Sargassum bocciferum* (gulf weed) is beautifully transparent. Other specimens shown are *Laminaria digitata*, stems and fronds, the former looking like sticks of ivory, *L. stenophylla*, *Fucus nodosus*, *F. serratus*, *Alaria esculenta*, *Halidryes siliquosa*, *Rhodomenia palmata*, *Rhodomenia pinnastroides*, *Zostera marina*, *Enteromorpha compressa*, &c. When sufficiently white, the weed is soured by a very weak solution of sulphuric or hydrochloric acid, and well washed. If the acid be added with the bleach the action is quicker. It is then acted on in the cold by about a tenth of its weight of sodium carbonate for 24 hours, then heated, filtered, and evaporated. The residual cellulose is pressed into cakes for use as a paper material. It is already bleached, and has only to be put at once into the paper beater. There are plenty of fibrous materials in the market, but there is no real substitute for rags, as, I believe, this will, to a great extent, prove to be.

The whole of the plant is thus accounted for; in the *Laminaria* the average yield is as follows:—

On the air-dried plant—

Extracted by water ..	30
Extracted by acid ..	5
Extracted by sodium carbonate = Algin	35
Cellulose ..	10
Moisture ..	20
	100

This plant is the only one now employed in making kelp; the least exposure to rain washes out the salts, and renders it useless for this purpose. It does not, however, interfere with its use for extracting the Algin, which is insoluble in water. For this purpose, if the salts are sacrificed, it is improved by exposure to rain and light. The wet weed, however, keeps perfectly well if access of air be prevented, for instance in a properly constructed "Silo," and there is no reason that any of it should be lost.

Applications of Algin.

Algin has properties which should make it useful for several applications in the soluble form. As a stiffener of fabrics, although not so rigid as starch, it fills the cloth

better, is tougher, more elastic, and more transparent. It mixes in all proportions with starch and dextrine, and imparts to the mixture these properties. Unbleached, it forms a cheap material for dressing winscys and such dark goods. Passed through an acid bath, the coating becomes glossy and insoluble, and thus a vegetable mordant is available for dyeing. Lime-water, and salts of calcium, barium, and several metallic salts, may be employed for a similar purpose, one of its peculiarities being the ease with which it is rendered insoluble.

I shall only just refer to its probable value as a food material on account of its nitrogenous character, as I have no edible specimens on the table which can be passed round for immediate consumption. As a cattle food there is a large opening for such a material. The agglutinating power of algin enables us to convert into solid blocks many substances which are with difficulty made to cohere. Silica, lime, magnesia, oxide of zinc, phosphate of lime, alumina, chalk plumbago, charcoal, and many other such substances can be converted into solid hard blocks. All of these and many more are exhibited. Some of these compounds may be made by mixing the algin with a solution, where both form a joint precipitate with another solution—*e.g.*, sodium silicate and calcium chloride. One application of this agglutinating character has already assumed importance. Charcoal has been long known as our best solid non-conductor of heat, and no doubt it would have been employed long ago as a covering for our steam-boilers had any medium been known capable of agglutinating it. That is now attained by this substance. My "carbon cement,"* for this purpose, contains 97 per cent of charcoal, 3 per cent. of algin being sufficient to make it cohere; and as that charcoal is made from seaweed, it is a remarkable fact that the whole covering is derived from that material. My friend Mr. Spiller, a high authority on the subject, has also found the solution of algin the best thing yet discovered for arresting incrustation in steam-boilers. We are not much troubled with this in Glasgow, but in the south, where the waters are hard, many such fluids are employed. Most of these are organic compounds combined with alkalis. One of the earliest and best was introduced some years ago by Mr. Spiller himself, and I am entirely indebted to him for suggesting the application of algin to this purpose. He speaks of it as highly efficient in precipitating the lime in such a fine state of division that it can easily be blown off from the cock. So that we now propose seaweed in one form or another as a most comfortable internal and external application to our steam-boilers. In fact several large steamers are already ploughing the ocean, assisted in their daily conflicts with heavy seas by weapons borrowed from these opponents.

The insoluble form of algin is very like horn, and as it can be pressed into moulds of any size it may be used instead of that article.

It also appears to be an excellent non-conductor of electricity, and in combination with certain other substances may assist in providing the cheap non-conducting material, which shall be impervious to moisture, now so much required for underground telegraph and telephone wires.

It is an efficient agent for emulsifying oils, and, being coagulated by alcohol, for fining wines and spirits.

These are some of the probable applications of algin, and, seeing that the substance is new, and the source abundant, I shall not be bold enough to predict what it may not be used for.

Phosphorus Sesqui-sulphide.—M. Isambert.—The author has succeeded in obtaining this compound from ordinary phosphorus. It had been previously prepared from red phosphorus by M. Lemoine.—*Comptes Rendus*.

* Carbon cement forms a very light, inodorous, and cheap material for covering steam boilers. Over 20,000 square feet have already been applied to boilers and piping.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, May 26th, 1883.

Prof. CLIFTON, President, in the Chair.

MR. G. GRIFFITH read a paper "*On the Graphical Representation of Musical Intervals*," in which he gave an account of previous attempts to represent musical intervals in a graphical manner, and exhibited an enlargement of a diagram published by Dr. Pole, in Sir F. Ouseley's "*Treatise on Harmony*." In this diagram the musical intervals contained in one octave are represented by the differences between the logarithms of the vibration-numbers forming them. Mr. Griffith proposes to apply this principle to the whole musical scale. Retaining the lines used in ordinary music he inserts a faint line between these at unequal distances to represent the tones and semi-tones. Several diagrams were exhibited in which this principle was applied to the representation of intervals to the sequence of the keys in the major diatonic scale and to actual music.

Mr. W. G. BLAKELY and Dr. COFFIN considered that it would be a great help to students to have the method proposed. Mr. Blakely considered that it combined the advantages of the tonic sol-fa and ordinary notation. Dr. Coffin thought that it might become generally used.

A paper by Dr. J. FLEMING "*On a Phenomenon of Molecular Radiation in Incandescent Lamps*," was read. When the carbon filament in an Edison lamp volatilises, the vapour is condensed on the glass in a cloud. When the copper electrode is volatilised the copper is likewise deposited, but there is a bare space or line left on the glass in the plane of the filament, forming, as it were, a shadow of the filament. Dr. Fleming explains this on the supposition that the copper particles are thrown off in straight lines, as in a Crookes's vacuum. This shadow is not noticed in the carbon deposits. Dr. Fleming also remarks that the colour of a thin copper film is the same as a thin layer of gold in transmitted light.

Mr. W. BAILY read a paper on "*An Illustration on the Crossing of Rays*." He took the case of three rays of homogeneous light of the same intensity and parallel to one plane, and polarised so that the vibrations were also parallel to the plane; and he exhibited and explained diagrams showing the motion which would occur under the circumstances.

Prof. F. GUTHRIE exhibited one of Chladni's plates bearing a striking resemblance to one of these figures.

Mr. BAILY thought the analogy might be a real one.

Professor CLIFTON described an improvement which he had made in the glass insulating stem he had exhibited to the Society on a former occasion. This stem had a glass cup encircling it and of a piece with the stem. Sulphuric acid was put into the cup. The new pattern had a hole formed into the bottom of the cup, and the upper part of the stem fitted into this hole like a stopper. It could thus be removed at will, and the acid renewed.

Professor AYRTON stated that he had used a similar arrangement for nearly two years, a narrow-necked glass bottle taking the place in the cup.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, June 4, 1883.

GEORGE BUSK, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

Mr. George Claudius Ash and Mr. Henry Swainson Cowper were elected Members of the Royal Institution.

The Managers reported that they had re-appointed

Professor James Dewar, M.A., F.R.S., as Fullerian Professor of Chemistry.

Two Candidates for Membership were proposed for Election.

The presents received since the last Meeting were laid on the table, and the thanks of the Members returned for the same.

NOTICES OF BOOKS.

Manual of Assaying Gold, Silver, Copper, and Lead Ores.
By WALTER LEE BROWN, B.Sc. Chicago: Jansen McClurg and Co. 1883.

THIS little manual cannot in any sense be termed a scientific work on the subject of which it treats, nor indeed has the author attempted to make it such: the object has been to furnish a guide to those who, having had no previous technical, or especially scientific, education, desired to learn something of the practical assaying of gold and silver ores. In this respect the book will form an excellent elementary guide to the important art of assaying.

In the first chapters the essential tools required by the assayer in his operations are figured and described, such as tongs, crucibles, and cupels, including several forms of furnaces adapted for the employment of liquid fuel as a source of heat, and which are not yet, so far as we are aware, to be found in use in this country. The processes for testing the reagents and fluxes employed in the operations, and the estimation of silver in litharge and lead, necessary for the correction to be applied when these substances are employed, are clearly described.

The instructions contained in the chapter on the assaying of gold and silver ores by the scorification and crucible processes are in every respect of a thoroughly practical kind, and we think with these before him it would be difficult for even a beginner to go wrong, each operation being explained, what to expect, and the inferences to be drawn from the appearance of the crucible, cupel, or metallic bead.

The account of the dry assay of copper ores might, in our opinion, have been omitted except in so far as affording the student instruction in furnace manipulation, as those who have had any experience in the subject can understand how very little of practical utility can be compressed into four pages of very wide print. For the estimation of sulphuretted lead ores the well-known "ten-penny" nail method is given, but no mention is made of the use of iron pots, which would have been of interest to the student.

In a lengthy appendix a heap of miscellaneous information is brought together concerning assaying, which will be of much service. Luckow's electrolytic method for copper is here given, but no account is made of Gay-Lussac's "wet" process for silver, nor is there any mention of the necessity for "checks" being employed in assaying bullion.

In spite of the few faults we have to find with this book we feel sure that the lucid manner in which the operations are described will render it of considerable value to the practical metallurgist and assayer.

New Method for the Synthesis of the Alkyl-nitrous Acids.—G. Chancel.—Nitric acid, when acting directly upon an alkyl derivative of acetylacetic ether, produces alkyl-nitrous acid. Thus, the methylic, ethylic, and propylic derivatives of acetylacetic ether, when submitted to the action of nitric acid, yield, respectively, ethyl-nitrous, propyl-nitrous, and butyl-nitrous acids, which are the compounds designated by M. Victor Meyer as dinitro-ethane, dinitro-propane, and dinitro-butane. The nitric acid used should be of about 1.35 sp. gr., and only small quantities should be acted on at once.—*Comptes Rendus*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 21, May 21, 1883.

Critical Point of the Liquefiable Gases.—J. Jamin.—This paper will, if possible, be inserted at length.

Composition of Combustible Mineral Substances.—M. Boussingault.—The author gives an account of the bitumen of the "fire-wells" at Ho-Tsing, in the Chinese province of Szetchuan, of the bitumen of Judea, of the fossil resins of the auriferous alluvium of New Granada, the coal of Canoas, near Bogota, the anthracites of Chili and New Granada.

Treatment of Waters derived from Washing Wools.—MM. Delattre.—The waters are first treated with a mixture of hydrochloric acid and ferric chloride to liberate the fatty acids, which are then skimmed off. The residual acid water is then treated with milk of lime, which precipitates certain impurities.

Deformation of Polarised Electrodes.—M. Gouy.—The author's experiments prove that a mechanical effect is produced upon solid electrodes by polarisation. When formed of a slender metallic plate they are deflected.

Electro-dynamic Interference of Alternate Currents.—A. Oberbeck.—A claim of priority as against M. Brillouin.

Certain Double Salts of Lead.—G. André.—The author has obtained a third lead-ammonium chloride (see *Comptes Rendus*, xcvi., p. 435). The double chlorides prepared by digesting litharge in a solution of ammonium chloride contain a small quantity of lead oxychloride. Certain double bromides have been obtained in the same manner.

Solubility of Strychnine in Acids.—MM. Hanriot and Blarez.—Strychnine dissolves with difficulty in acids, the solubility being greater as the acid is more dilute. If a concentrated solution of a neutral salt of strychnine is treated with a small excess of acid, there is formed a precipitate. The authors have studied in detail the behaviour of strychnine with the sulphuric and hydrochloric acids.

A Saccharine Substance obtained from the Lungs and the Sputa of Phthisical Patients.—A. G. Pouchet.—The compound obtained is represented by the formula $C_{12}H_{18}O_9, H_2O$.

Zymase of Human Milk.—A. Béchamp.—The casein of human milk is not absolutely identical with that of cows' milk. The zymase of human milk fluidifies and saccharifies starch-paste almost as intensely as diastase or human dialozymase. The rotatory power of this zymase is much greater than that of the galacto-zymase of the cow.

Bulletin de la Société Chimique de Paris.
No. 8, April 20, 1883.

Study on the Combustion of Explosive Gaseous Mixtures.—MM. Mallard and Le Chatelier.—Continued from pp. 2, 98, and 268 of the present volume. The author examines the speed of propagation of the flame, the influence of the diameter of the tubes, and of vibratory movements; the results of experiments with mixtures of formene and air, of hydrogen and air, coal-gas and air; carbon monoxide and oxygen, hydrogen and chlorine, and hydrogen and oxygen.

Numerical Relations between Thermic Data.—D. Tommasi.—Already noticed in the *Comptes Rendus*.

A Special Form of Gas-holders.—Dr. L. G. de Saint Martin.—This memoir cannot be reproduced without the five accompanying illustrations.

Law of Thermic Substitution-constants.—D. Tommasi.—The author upholds the exactitude of his law by comparing the combination-heats of a number of compounds as determined experimentally with those calculated by his law.

Researches on the Passage of Alcoholic Liquors through Porous Bodies (Second Notice).—H. Gal.—The author has studied the influence of temperature on this phenomenon. He finds that alcohol in bladders and exposed to temperatures of -10° , lost strength as decidedly as at $+50^{\circ}$, though more slowly. An increase of strength is observed only when the bladders were placed in a medium where watery vapour was absorbed by quicklime. The nature of the membrane, as gold-beater's skin or parchment, had no effect save upon the speed of the evaporation.

Hydrates of Chlorine.—E. Maumené.—This paper has been already communicated to the CHEMICAL NEWS by the author.

Ammoniacal Bromides and Oxy-bromides of Zinc.—G. André.

Salts formed by Glycolic Acid.—R. de Forcrand.—These two papers have been already noticed.

Oil of Angelica of the Roots.—Laurent Naudin.—Already noticed.

Notes on the Soda Industry.—A. Scheurer-Kestner.—In this bulky memoir the author treats in succession of the loss of soda in the manufacture by the Le Blanc process; of the presence of vanadium, fluorine, and phosphorus in the lixivium of crude soda; of the preparation of caustic soda and the causes of loss; of the more economical use of fuel; the use of pyrites in the manufacture of sulphuric acid, and of the importance of the soda manufacture.

Cosmos Les Mondes.
Tome v., No. 1, May 5, 1883.

The Compound Incorrectly Named Chlorine Hydrate.—E. Maumené.—Already inserted.

Combination Calories of the Soluble Compounds of Zinc.—Dr. T. Tommasi.—Already noticed.

May 12, 1883.

This number contains no original chemical matter.

MEETINGS FOR THE WEEK.

TUESDAY, 12th.—Royal Medical and Chirurgical, 8.30.
Photographic, 8.

WEDNESDAY, 13th.—Microscopical, 8.

THURSDAY, 14th.—Royal, 4.30.
Philosophical Club, 6.30.

UNIVERSITY COLLEGE, BRISTOL.

GILCHRIST SCHOLARSHIP.

A SCHOLARSHIP of the value of £50 annually, tenable for THREE YEARS, will be awarded at this College in September, 1883. Intending Candidates must forward their names for approval to the Principal, before the 16TH JUNE, previous to entering for the MATRICULATION EXAMINATION of the UNIVERSITY OF LONDON, held in June, 1883; and the one who passes highest in the HONOURS DIVISION will obtain the Scholarship, conditional on his studying at University College, Bristol, with a view to graduation in the University of London.

For further information with regard to this and other Scholarships tenable at the College apply to

J. N. LANGLEY, LL.D., Registrar and Secretary.

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A TREATISE ON ELECTRICITY AND MAGNETISM. (GENERAL PHENOMENA AND THEORY).

BY

E. MASCART,

PROFESSOR IN THE COLLEGE DE FRANCE, AND DIRECTOR OF THE CENTRAL METEOROLOGICAL BUREAU;

AND

J. JOUBERT,

PROFESSOR IN THE COLLEGE ROLLIN.

TRANSLATED BY **E. ATKINSON, PH.D., F.C.S.,**

PROFESSOR OF EXPERIMENTAL SCIENCE IN THE STAFF COLLEGE.

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THE CHEMICAL NEWS.

VOL. XLVII. No. 1229.

ON THE QUALITATIVE SEPARATION OF ZINC, NICKEL, AND COBALT.

By OSCAR C. S. CARTER.

THIS separation is based on well-known reactions of Zn, Ni, and Co with various reagents. The advantages over the usual method of separation are that you avoid the oxidation of NiS and CoS, and hence obtain perfectly clean and clear filtrates, and complete precipitation is insured, and the separation is rapid and conclusive.

Separation.

Treat a solution of the chlorides with Br water and NaOH in excess in the cold; the Ni and Co are precipitated as hydrated sesquioxides $\text{Ni}_2(\text{OH})_6$ and $\text{Co}_2(\text{OH})_6$ (black), which settle rapidly. The hydrate of zinc $\text{Zn}(\text{H}_2\text{O}_2)$ goes in solution in the excess of NaOH as Na_2ZnO_2 (sodium zincate); filter; from the filtrate the Zn is completely precipitated as ZnS with $(\text{NH}_4)_2\text{S}$, clean and white.

Dissolve the hydrates of Ni and Co in HCl, and add NH_4HO until alkaline, and then ferricyanide of potassium. The presence of the Co is at once made known by the well-known blood-red colouration that ferricyanide gives with salts of Co, similar in appearance to $\text{Fe}_2(\text{CNS})_6$. On boiling the solution the Ni is precipitated as a copper-red-precipitate, while the red colour of the Co solution remains unchanged. Filter off the precipitated Ni, and in the filtrate the Co remains, which can be completely precipitated with $(\text{NH}_4)_2\text{S}$ as CoS, and still further recognised by the blue colour it imparts to a borax bead.

In this separation the Br oxidises the $\text{Ni}(\text{OH})_2$ and $\text{Co}(\text{OH})_2$ to $\text{Ni}_2(\text{OH})_6$ and $\text{Co}_2(\text{OH})_6$, which settle quicker and can be filtered more rapidly, and it seems to have no effect on the Zn.

The Br water and NaOH are added in the cold, because at 50°C . about three times as much alkali solution is required to dissolve $\text{Zn}(\text{OH})_2$ as at 17°C . (*Journ. Am. Chem. Soc.*, February, 1880, ii., 29), and if the solution were boiled, zinc oxide would separate from dilute solutions; hence concentrated solutions of NaOH or KOH must be used.

The addition of an alkali solution so dilute as 1-10th normal in case of KOH will not dissolve $\text{Zn}(\text{OH})_2$, however much is added. NaOH is not required in so large excess to dissolve $\text{Zn}(\text{OH})_2$ as KOH is. The entire separation can be performed in one and a half hours.

Laboratory High School, Philadelphia.

ON A NEW METHOD OF DETERMINING SULPHUR IN ORGANIC SUBSTANCES.

By PETER CLAEISSON.

THE author, after criticising previous methods, describes his own process, depending on the complete oxidation of the substances in a mixed current of oxygen and nitric oxide. The apparatus is fitted up as follows:—One end of the combustion tube, which is rather longer than the combustion-furnace, is drawn out to a tube 20 c.m. long and $\frac{1}{2}$ c.m. wide. The drawn out portion is bent at an obtuse angle. At the same time are made four rolls of platinum wire-gauze, each about 7 c.m. long. The nitric oxide gas is prepared from copper and ordinary nitric acid in a Kipp apparatus. The gas delivery-tube with its cock is best ground in. A caoutchouc tube may be substituted,

but before being used it must be dipped in melting paraffin, and immediately inserted in the apparatus. Nitric oxide gas is evolved in such an apparatus as quietly and regularly as carbonic acid or hydrogen. After use the acid is poured out of the apparatus, as the copper is somewhat attacked by the fumes even when the apparatus is closed. The apparatus is emptied through a cock ground in the lower vessel. The same acid may be used in such an apparatus eight or ten times. Both the oxygen and the nitric oxide must be passed through washing bottles filled with water. When the caoutchouc tube connecting the nitric oxide apparatus with the washing bottle is well moistened before use it is but little attacked.

The combustion-tube is charged as follows:—After the bend comes a platinum roll; then, and at the distance of about 10 c.m., a boat with fuming nitric acid. The boat is best thrust half-way into the tube, filled with acid by means of a pipette, and thrust into its place. At about 10 c.m. from the boat follows a second platinum roll, and 5 c.m. from that the third. Immediately after this follows a boat with the substance, and then the last platinum roll. The fork-shaped delivery tube is connected with the combustion-tube by means of a cork, and with the washing-bottles by means of flexible tubing. The drawn-out and bent end of the combustion-tube passes into a small flask holding about 100 c.c. This flask serves as a receiver, and contains water enough to close the aperture of the tube. The boat with the nitric acid is at the beginning of the operation protected, if necessary, from too strong evaporation. A moderate current of about equal quantities of oxygen and nitric oxide is allowed to stream through the tube. The contents of the tube soon become red. The platinum rolls before and behind the boat with nitric acid are also gently ignited. When this point is reached the roll before the substance is also heated to redness. This is especially important when volatile substances such as hydrosulphates or sulphides are burnt, because the primary oxidation products are very apt to draw back. The combustion is now carried on as in an ultimate analysis, progressing slowly backwards. The colour of the tube between the two boats serves as an indicator. If no colour is perceived it is a sign that all available oxygen is consumed, and the combustion must be retarded. The nitric acid in the boat serves as a reserve. The hot gases which sweep over convey always with them sufficient oxygen compounds to burn unconsumed portions at the last roll. When the gases at their exit from the tube appear red during the entire combustion we may be certain that the process was complete.

Readily volatile compounds are enclosed in small glass globes, and if extremely volatile two boats with nitric acid are placed, the one close behind the other. If the combustion is conducted slowly enough no phenomena of ignition take place, but the process can be much accelerated without danger. These phenomena are not attended with explosions, but a faintly luminous flame moves slowly between the platinum roll and the boat and ignites the substance. If this takes place the gas-taps are closed for a moment, and the flame expires at once. With aromatic substances, especially naphthaline compounds, it may occur that the substance is first nitrised, and then burns like tinder. Even in this case no unburnt matter passes through the last platinum roll if there is sufficient nitric acid in the boat. It is the general rule that the more rapid the combustion the more nitric acid is required, and inversely. When everything in the boat is burnt we proceed with the heating until both the nitric acid and the sulphuric acid formed have distilled over into the receiver. Sometimes, though very seldom, dark drops are deposited near the nitric acid boat. These contain nitro-compounds of sulphuric acid, which on heating evolve nitric oxide. If the tube contains an excess of oxygen condensation sets in, which inevitably occasions a violent regurgitation of the water in the receiver. If, therefore, such drops appear only nitric oxide is allowed to pass over at the beginning

of the distillation of the nitric acid. In any case oxygen alone is finally passed through until the interior of the tube is colourless. When the flame goes out oxygen is still passed through for a short time, one of the washing-bottles is detached from the tube, and the whole is let become quite cold. The contents of the receiver are poured into a porcelain capsule; the tube and the receiver are washed with water till the reaction of sulphuric acid is no longer to be recognised; the whole is evaporated to dryness on the water-bath, and the sulphuric acid is determined as usual. The tube is best washed as follows:—After the receiver is removed the drawn-out end of the tube is rinsed with water, and it is then fitted with a flexible tube, pinchcock, and jet like a burette. The platinum rolls are shaken out; water is let in and emptied through the pinchcock into the capsule, repeating this process till the tube is free from sulphuric acid.—*Zeitschrift für Analytische Chemie*.

ON THE PREPARATION OF *LÆVO-TARTARIC ACID*.*

By Dr. G. GORE, F.R.S.

As I believe there exists no accurate and complete description in English of the best process for preparing this remarkable substance (discovered by M. Pasteur), I beg leave to communicate to the Birmingham Philosophical Society the following account of its preparation, received by me (January, 1882) from my friend M. Jungfleisch.

"We prepare at the outset the double racemate of sodium and ammonium; we divide a portion of racemic acid into two exactly equal parts by weight; we exactly neutralise the first portion (dissolved in boiling water) by means of pure carbonate of sodium; then the second by ammonia; and finally, we mix the two liquids, and filter the mixture if necessary. It remains then to evaporate the solution in a hot water bath until it possesses the requisite concentration. That concentration is necessarily variable with the temperature at which the crystallisation operates, and it will be more considerable in summer than in winter. In a general way that should be regulated in such a manner that by cooling, a litre of the solution deposits 150 to 160 grammes of the right and left-handed crystals. Basing upon this, it is easy to determine by two or three tentative essays the density which corresponds to the temperature of the laboratory. We find thus the determination to be made at the temperature of the water-bath, the numbers which vary between 1·24 for winter, and 1·28 for summer.

"This treatment renders necessary that the evaporation of the liquors be repeated a large number of times; or the employment of hydrometers is a little advantageous for following that operation and recognising when the heated solution has attained the necessary density. It will be better to adopt the following process:—

"We prepare a liquid which presents the necessary density (a mixture of water and sulphuric acid, for example), and into it plunge a little hollow bead of glass, which is ballasted just so that its point is level to the surface; we seal at once that point by the flame of a lamp. This little apparatus, placed in the saline solution to be evaporated, sinks for a time to the bottom of the capsule; meanwhile, the water disappearing little by little, will the point mount to the surface of the liquid possessing the density for which the float has been regulated. The very small volume of the little bottle permits the operation at all times upon the smallest quantities of liquid, which always are on hand at the end of each treatment.

"During the evaporation, a portion of the ammonia escapes with the vapour of water; it is necessary to replace this when the operation is finished. An excess of that alkali favours the crystallisation when added in quantity sufficient to give a reaction freely alkaline.

"The solution made alkaline, and possessing the requisite density, is poured into a crystalliser having roughened edges, which is covered immediately with a ground glass plate accurately closing it. The vapour of water emitted by the hot liquid in its condensation wets the glass at the edges of the crystalliser, and forms between them by capillarity a kind of hydraulic closure which permits the liquid to entirely cool in undisturbed supersaturation. We must always take care to place the vase in a place whereof the temperature is nearly constant, or at least not presenting during the day and the night a digression very considerable.

"The next day, the solution having acquired the atmospheric temperature, we wet our hands carefully, we take between the fingers a small fragment of the right-handed tartrate of sodium and ammonium, we wash it by submitting it for a moment to a jet of water from a wash bottle, and, lifting the sheet of glass, we allow it to fall into the right hand part of the crystalliser. We do the same with a fragment of the left-handed salt, which we allow to fall upon the left, and we replace immediately the sheet of glass. The two crystals occupy thus almost the middle of two radii, situated on the prolongation of the one by the other. It is necessary to avoid the introduction of all crystalline dust, which determines rapidly a confused crystallisation. The wet crystals reproduce not the same phenomena; they make suitable, in some manner, the liquid bed which envelops them; they increase with slowness, and do not attain until after two or three days their greatest maximum; they remain perfectly isolated when we operate properly, and the crystals upon the right contain nothing but dextro-tartrate, whilst those on the left are formed exclusively of left. It is easy to obtain thus crystals clear isolated, weighing each 180 to 200 grammes. When they cease to accrete, we lift or we drain them, and after having restored by concentration the liquid to requisite density we repeat the same operation a second time, and a third, and so on to complete exhaustion of the solution.

"It is advantageous to operate in crystallisers containing one to two litres of liquid. In larger vessels the quantity of salt to deposit being considerable, a variation of the temperature may provoke the deposition of multiple crystals, which disturbs the cleanliness of the result. We may, it is true, suppress that inconvenience by introducing into the supersaturated solution several (or many) fragments of each species.

"The right and left handed crystals having been separated, we dissolve by means of a water-bath the *lævo-tartrate* in the least possible quantity of water, we add a slight excess of ammonia, and we allow the liquid to cool, agitating it in order to disturb the crystallisation; we dry in the open air the crystalline pulp obtained; we wash it rapidly in a funnel by means of a small quantity of cold water, and we repeat many times these operations, until the crystals obtained are pure. These last may then be transformed into a salt of calcium, next into *lævo-tartaric acid*. The wash-waters arising from the purification furnish additional *lævo-tartrate* to purify, then the mother waters which we add to the liquors to be separated."

Racemic acid may be obtained at a very moderate price from the original makers, MM. Wagenmann, Seybel, and Co. (Fabrik Chem. Producte in Liesing bei Wien) IV. Resselgasse 5, Vienna, who obtain the raw material from the wine district near Thann and Mulhouse, and separate the acid from time to time in their tartaric acid manufactory. The only persons of whom I have been able to obtain the *lævo-acid* ready prepared are MM. Billault et Billaudot, Pharmaciens, 22, Rue de la Sorbonne, Paris. I was favoured with their address by M. Pasteur.—(G. G.).

* Reprinted from the *Proceedings of the Birmingham Philosophical Society*, vol. iii, p. 325.

A RECALCULATION
OF
THE ATOMIC WEIGHTS.*

By FRANK WIGGLESWORTH CLARKE, S.B.,
Professor of Chemistry and Physics in the University of Cincinnati.

OXYGEN.

THE ratio between oxygen and hydrogen is the foundation upon which the entire system of atomic weights depends. Hence, the accuracy of its determination has, from the beginning, been recognised as of extreme importance. A trifling error here may become cumulative when repeated through a moderate series of other ratios.

Leaving out of account the earliest researches, which have now only a historical value, we find that three methods have been employed for fixing this important constant. First, the synthesis of water, effected by passing hydrogen gas over red-hot oxide of copper. Secondly, the exact determination of the relative density of the two gases. Thirdly, by weighing the quantity of water formed upon the direct union of a known volume of hydrogen with oxygen.

The first of these methods has been employed in three leading investigations, namely, by Dulong and Berzelius,† by Dumas, and by Erdmann and Marchand. The essential features of the method are in all cases the same. Hydrogen gas is passed over heated oxide of copper, and the water thus formed is collected and weighed. From this weight and the loss of weight which the oxide undergoes, the exact composition of water is readily calculated. Dulong and Berzelius made but three experiments, with the following results for the percentages of oxygen and hydrogen in water:—

O.	H.
88.942	11.058
88.809	11.191
88.954	11.046

These figures, rather roughly determined, and by no means exact enough to meet the requirements of a modern science, give a mean value of 16.021 for the atomic weight of oxygen. As the weighings were not reduced to a vacuum, this correction was afterwards supplied by Clark,‡ who showed that these syntheses really make $O = 15.894$; or, in Berzelian terms, if $O = 100$, $H = 12.583$.

In 1842 Dumas§ published his elaborate investigation upon the composition of water. The first point was to get pure hydrogen. This gas, evolved from zinc and sulphuric acid, might contain oxides of nitrogen, sulphur dioxide, hydrosulphuric acid, and arsenic hydride. These impurities were removed in a series of wash bottles; the H_2S by a solution of lead nitrate, the H_3As by silver sulphate, and the others by caustic potash. Finally, the gas was dried by passing through sulphuric acid, or, in some of the experiments, over phosphorus pentoxide. The copper oxide was thoroughly dried, and the bulb containing it was weighed. By a current of dry hydrogen all the air was expelled from the apparatus, and then, for ten or twelve hours, the oxide of copper was heated to dull redness in a constant stream of the gas. The reduced copper was allowed to cool in an atmosphere of hydrogen. The weighings were made with the bulbs exhausted of air. The table (see next page) gives the results.

Column A contains the symbol of the drying substance. B gives the weight of the bulb and copper oxide. C, the weight of bulb and reduced copper. D, the weight of the vessel used for collecting the water. E, the same plus the water. F, the weight of oxygen. G, the weight of water formed. H, the crude equivalent of H when $O = 10,000$.

* Smithsonian Miscellaneous Collections. "The Constants of Nature."

† Thomson's "Annals of Philosophy," July, 1821, p. 50.

‡ Philosophical Magazine, 3rd Series, 20, 341.

§ Comptes Rendus, 14, 537.

I, the equivalent of H, corrected for the air contained in the sulphuric acid employed. This correction is not explained, and seems to be questionable.

In the sum total of these nineteen experiments, 840.161 grammes of oxygen form 945.439 grammes of water. This gives, in percentages, for the composition of water—Oxygen, 88.864; hydrogen, 11.136. Hence the atomic weight of oxygen, calculated in mass, is 15.9608. In the following column the values are given as deduced from the individual data given under the headings F and G:—

15.994
16.014
16.024
15.992
15.916
15.916
15.943
16.000
15.892
15.995
15.984
15.958
15.902
15.987
15.926
15.992
15.904
15.900
16.015

Mean .. 15.9607, with a probable error of ± 0.0070 .

In calculating the above column several discrepancies were noted, probably due to misprints in the original memoir. On comparing columns B and C with F, or D and E with G, these anomalies chiefly appear. They were detected and carefully considered in the course of my own calculations, and, I believe, eliminated from the final result.

The paper by Erdmann and Marchand* followed closely after that of Dumas. The method of research was essentially the same as that of the latter chemist, varying only in points of comparatively unimportant detail. The results are given in two series, in one of which the weighings were not actually made in vacuo, but were, nevertheless, reduced to a vacuum standard. The second series represents actual vacuum weighings. The quantity of water formed in each experiment was from 41.664 to 95.612 grammes. I give below only the percentages of oxygen and hydrogen in water as deduced from Erdmann and Marchand's data:—

First Series.	
O.	H.
88.836	11.164
88.821	11.179
88.874	11.126
88.868	11.132
Second Series.	
O.	H.
88.887	11.113
88.898	11.102
88.895	11.105
88.899	11.101

Hence the atomic weight of oxygen is as follows:—

First Series.	Second Series.
15.915	15.997
15.891	16.015
15.976	16.010
15.966	16.016

Mean 15.9369 ± 0.0138 Mean 16.0095 ± 0.0030

* Journ. f. Prakt. Chem., 1842, Bd. 26, s. 461.

	A.	B.	C.	D.	E.	F.	G.	H.	I.
H ₂ SO ₄	291'985	278'806	480'807	495'634	13'179	14'827	1250'5	1249'6
"	344'548	324'186	488'227	511'132	20'362	22'905	1249'0	1248'0
"	316'671	296'175	439'711	462'764	20'495	23'053	1248'1	1247'2
P ₂ O ₅	625'829	568'825	884'190	948'323	57'004	64'044	1250'6	1249'0
H ₂ SO ₄	804'546	728'182	887'331	973'291	76'364	85'960	1256'2	1254'6
"	533'726	490'155	867'159	916'206	43'571	49'047	1256'3	1255'0
"	661'915	627'104	839'304	878'482	34'811	39'178	1254'6	1253'3
P ₂ O ₅	612'625	566'738	824'624	876'244	45'887	51'623	1250'0	1249'0
"	904'643	844'612	822'660	890'246	60'031	67'586	1258'3	1255'1
H ₂ SO ₄	642'325	590'487	741'095	799'417	51'838	58'320	1250'4	1248'9
P ₂ O ₅	587'645	535'137	874'832	933'910	52'508	59'078	1251'2	1249'0
"	673'280	613'492	931'487	998'700	59'789	67'282	1253'3	1250'8
H ₂ SO ₄	660'855	598'765	682'374	752'273	62'090	69'899	1257'7	1254'8
"	642'325	590'487	741'097	799'455	51'838	58'360	1258'1	1256'2
"	937'845	881'362	1064'762	1128'319	56'483	63'577	1255'3	1252'2
P ₂ O ₅	756'352	719'563	878'640	920'030	36'789	41'390	1250'6	1249'1
"	754'162	720'000	887'817	926'275	34'162	38'458	1257'3	1255'1
"	759'762	727'632	888'662	924'837	32'133	36'175	1257'5	1254'7
"	747'652	716'825	877'862	912'539	30'827	34'677	1248'8	1248'0
Means									1253'3 1251'5

The effect of discussing these two series separately is somewhat startling. It gives to the four experiments in Erdmann and Marchand's second group a weight vastly greater than their other four and Dumas's nineteen taken together. For so great a superiority as this there is no adequate reason; and it is highly probable that it is due almost entirely to fortunate coincidences, rather than to greater accuracy of work. We will, therefore, treat Erdmann and Marchand's experiments as one series, giving all equal weight, and then combine them with the results obtained by Dumas. We now have—

By Dumas O = 15'9607 ± 0'0070
By Erdmann and Marchand O = 15'9733 ± 0'0113

General mean O = 15'9642 ± 0'0060

In discussing the relative density of oxygen and hydrogen gases we need only consider the more modern researches of Dumas and Boussingault, and of Regnault. As the older work has some historical value, I may in passing just cite its results. For the density of hydrogen we have 0'0769, Lavoisier; 0'0693, Thomson; 0'092, Cavendish; 0'0732, Biot and Arago; 0'0688, Dulong and Berzelius. For oxygen there are the following determinations: 1'087, Fourcroy, Vauquelin, and Séguin; 1'103, Kirwan; 1'128, Davy; 1'088, Allen and Pepys; 1'1036, Biot and Arago; 1'1117, Thomson; 1'1056, De Saussure; 1'1026, Dulong and Berzelius; 1'106, Buff; 1'1052, Wrede.*

In 1841 Dumas and Boussingault† published their determinations of gaseous densities. For hydrogen they obtained values ranging from 0'0691 to 0'0695; but beyond this mere statement they give no details. For oxygen three determinations were made, with the following results:—

1'1055
1'1058
1'1057

Mean .. 1'10567 ± 0'00006.

If we take the two extreme values given above for hydrogen, and regard them as the entire series, they give us a mean of 0'0693 ± 0'00013.

This mean hydrogen value, combined with the mean oxygen value, gives for the atomic weight of the latter element the number 15'9538 ± 0'031.

Regnault's researches, published four years later,‡ were

* For Wrede's work see *Berzelius's Jahresbericht* for 1843. For Dulong and Berzelius, see the paper already cited. All the other determinations are taken from "Gmelin's Handbook," Cavendish edition, vol. 1, p. 279.

† *Comptes Rendus*, xii., 1005. Compare also with Dumas, *Comptes Rendus*, xiv., 537.

‡ *Comptes Rendus*, xx., 975.

of a more satisfactory kind. Indeed they are among the classics of physical science, and probably approach as near to absolute accuracy as is possible for experiment.

For hydrogen three determinations of density gave the following results:—

0'06923
0'06932
0'06924

Mean .. 0'069263 ± 0'000019.

For oxygen four determinations were made, but in the first one the gas was contaminated by traces of hydrogen, and the value obtained, 1'10525, was therefore rejected by Regnault as too low. The other three are as follows:—

1'10561
1'10564
1'10565

Mean .. 1'105633 ± 0'000008.

Now, combining the hydrogen and oxygen series, we have for the atomic weight of oxygen 15'9628 ± 0'0044.*

Upon combining the result of Regnault's work with that from Dumas and Boussingault's we get the following value:—

From Dumas and Boussingault O = 15'9538 ± 0'031
From Regnault O = 15'9628 ± 0'0044

General mean O = 15'9627 ± 0'0043

This result, it will be seen, agrees remarkably well with that obtained in the experiments upon the synthesis of water.

The third method indicated at the beginning of this discussion has been recently employed in part by J. Thomsen,† of Copenhagen. Unfortunately this chemist has not published the details of his work, but only the end results. These serve to confirm the values for oxygen fixed by other methods, but they cannot well be included in the systematic discussion. Partly by the oxidation of hydrogen over heated copper oxide, and partly by its direct union with oxygen, Thomsen finds that

* Since these computations were made Prof. J. Le Conte has called my attention to the existence of slight numerical errors in Regnault's own reductions. As corrected by Le Conte, Regnault's figures give 1'105612 for the density of oxygen, and 0'069269 for that of hydrogen. Hence the atomic weight of O becomes 15'9611 instead of 15'9628. The difference is slight, but still it ought not to be ignored. All the computations in the body of this work, having been finished before I received Professor Le Conte's figures, must stand, nevertheless, as they are. For further details Le Conte refers to *Phil. Mag.*, (4), 27, p. 29, 1864; and also to the "Smithsonian Report for 1878," p. 428.

† *Ber. d. Deutsch. Chem. Gesellschaft*, 1870, s. 928.

at the latitude of Copenhagen, and at sea level, 1 litre of dry hydrogen at 0° and 760 m.m. pressure will form 0.8041 gramme of water. According to Regnault, at this latitude, level, temperature, and pressure, a litre of hydrogen weighs 0.08954 gramme. From these data $O = 15.9605$. It will be seen at once that Thomsen's work depends in great part upon that of Regnault, and yet that it affords an admirable reinforcement of the latter.

It is now plain, in conclusion, that all the different lines of research point to an atomic weight for oxygen a little below 16.00. Five distinct investigations confirm each other wonderfully. Upon combining the values obtained by the two chief methods we get the following final results:—

From synthesis of water .. $O = 15.9642 \pm 0.0060$
From gaseous densities .. $O = 15.9627 \pm 0.0043$.

In the general mean the atomic weight of oxygen becomes 15.9633, with a probable error of ± 0.0035 .*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 7, 1883.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

THE following certificates were read for the first time:—J. T. Barr, L. L. Garbutt, C. W. Stephens, P. H. Wright.

The PRESIDENT expressed his regret that a sufficient number of Fellows was not present to enable a ballot to take place; he hoped that a ballot would be held at the next meeting on June 21, which would be the last meeting of the session.

Dr. GLADSTONE then communicated "*Laboratory Notes*," by J. H. GLADSTONE and A. TRIBE. 1. On the Action of Light and Heat on Cane- and Invert-Sugars.—The authors have investigated the action of their well-known copper-zinc couple on a 5 per cent solution of sugar. No carbonic acid was evolved at ordinary temperatures, but at 100° C. carbonic acid was formed, and a small quantity of a substance which gave the iodoform reaction on treatment with iodine and potassium hydrate; this substance also gave acetic acid on treatment with potassium chromate and sulphuric acid. It was therefore thought at first that alcohol had been produced from sugar; further investigation showed that the carbonic acid came from some oxycarbonate of zinc formed during the washing of the couple, while the reducing body was a product of the action of heat upon the sugar solution. Many experiments were made in which a 5 per cent solution of cane-sugar was heated for some days: in all cases the iodoform-yielding substance was formed, even in the absence of air. Some experiments were also made as to the influence of light, air, and atmospheric germs on the conversion of cane-sugar into glucose. The authors conclude that this conversion takes place with extreme slowness when the cane-sugar solution is exposed to the action of light and air, singly or jointly. Light appears to be detrimental to the development of fungoid growths in a solution of cane-sugar exposed to atmospheric air. 2. On Hydroxylamine.—The copper-zinc couple reduces the hydrochloride of this base, ammonia being formed. 3. On the Recovery of Iodine from Organic Iodide Residues.—The residues are poured on an excess of copper-zinc couple, wet with water or alcohol. Zinc iodide is formed, which is extracted with hot water. The iodine is obtained in the free state by the action of hydrochloric acid and bleaching-powder. 4. A Residual Phenomenon

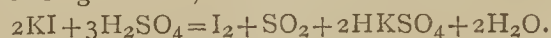
of the Electrolysis of Oil of Vitriol.—It was noticed that gas continued to be evolved from both the electrodes after the battery had been disconnected; this gas was oxygen. This phenomenon is probably due to the presence of Berthelot's persulphuric acid. 5. On an Alleged Test for Alcohol.—Davy suggests that traces of alcohol can be detected by the blue colour which is produced with a warm solution of molybdic anhydride in oil of vitriol. The authors find that many other reducing substances and sugar give the same reaction. 6. Reaction of the Copper-zinc Couple on Nitric Oxide.—When this gas is passed over the moist copper-zinc couple, ammonia, but no protoxide of nitrogen, is formed. Free nitrogen was substituted for nitric oxide, but no evidence as to the formation of ammonia could be obtained. 7. On the Reducing-action of Spongy Lead.—Spongy lead free from occluded hydrogen reduces nitrates to nitrites, ammonia being simultaneously formed. Spongy lead has no action upon an aqueous solution of potassium chlorate, but the addition of 1 per cent sulphuric acid causes a slow reduction to chloride. Lead filings cause similar reactions, but their activity is much less.

Mr. WARINGTON said the fact recorded by the authors that sugar solution when heated forms a reducing substance giving the iodoform reaction, was of great importance, and, moreover, threw some doubt on the conclusions drawn by Muntz as to the occurrence of alcohol in almost all natural waters, these conclusions depending on the iodoform reaction.

The SECRETARY then read the following "*Note on a Basic Ammonio-Copper Sulphate*," by S. U. PICKERING. The author stated in a previous paper (CHEMICAL NEWS, vol. xlvii., p. 182), that, on dilution, ammonio-copper sulphate solution throws down a basic precipitate containing only traces of ammonia. With strong solutions, however, different results are obtained. With nearly saturated solutions a violet blue substance is slowly deposited, which has the composition $4CuO, 5SO_4, 16NH_3$. When such a solution is diluted with a small quantity of water a violet-blue precipitate, $CuSO_4 \cdot CuO_2 \cdot NH_3 \cdot 5H_2O$, is deposited.

"*Notes on Loew and Bokornig's Researches on the Probable Aldehydic Nature of Albumen*," by A. B. GRIFFITHS. The author states that he has gone over a good portion of the experiments which led the above chemists to their conclusions, and in the present paper details one or two observations he has noticed in the case of the protoplasm of *Spirogyra*. The protoplasm, whether dead or alive, reduces a dilute alkaline solution of a cupric salt. The living cells when treated with a weak solution of sodium chloride under the microscope, form crystals. The author is therefore inclined to think that the reducing body is a glucose, and, moreover, it must be dextrose, because levulose does not form a crystalline compound with sodium chloride. The author does not give any analysis, or say how the crystals were identified, but states that most likely they have the formula $C_6H_{12}O_6 \cdot NaCl \cdot H_2O$.

"*Note on the Action of Sulphuric Acid, Sp. gr. 1.84, upon Potassium Iodide*," by H. JACKSON. It has long been known that when strong sulphuric acid acts upon potassium iodide there are produced hydric sulphide, sulphur dioxide, iodine, hydriodic acid, hydrio-potassic sulphate, and water; but no details as to the amounts produced have been published. The author finds that two principal reactions occur. The first when the sulphuric acid is in large excess, when the reaction is—



The second when there is just sufficient sulphuric acid to satisfy the potassium iodide used,—



To obtain these reactions perfectly it is necessary to have the sulphuric acid boiling. The analytical numbers are given upon which the above reactions are founded.

Dr. DEBUS said the reaction was interesting, as in the second equation the hydriodic acid first evolved reduced

* Le Conte's correction of Regnault's figures introduced here would make $O = 15.9622$ instead of 15.9633. Difference, 0.0011.

the sulphuric acid, hydric sulphide being formed. Under certain conditions hydric sulphide was obtained from the action of zinc upon sulphuric acid, the nascent hydrogen reducing the sulphuric acid. In both cases the sulphur changed its valency.

"*The Action of Nitrous Anhydride on Glycerin*," by O. MASSON. The author employed the pure glycerin of commerce, and generated the nitrous anhydride by the action of nitric acid, sp. gr. 1.35, on "porcelain arsenic." The gas was dried over fused calcium chloride, and then passed direct into the glycerin. The reaction takes place quietly; the glycerin greatly increases in bulk and mobility; its colour changes through yellow to brown, finally becoming dark green. Two layers of liquid form, an aqueous solution of nitrous acid and of oxidation-products of glycerin, and a layer which consists of the nitrous ether of glyceryl. These layers react upon each other, and should therefore be separated as soon as possible. By passing a rapid current of dry hydrogen, the author succeeded in distilling the ether at 100°, or 50° below its boiling-point. Analysis indicated the formula $C_3H_5(NO_2)_3$. The liquid was distilled several times; it is amber coloured, boils with decomposition at 150°, burns with a whitish flame, but does not explode under the hammer. It does not mix with water, but the ether is decomposed at the surface of contact. It cannot be preserved pure. When enclosed in sealed tubes it produces pressure enough to shatter the glass.

The Society then adjourned to June 21, when a ballot for the election of Fellows will be held, and a paper "On Distillation *in vacuo*" will be read by Prof. McLeod.

PHYSICAL SOCIETY.

Saturday, June 9th, 1883.

Prof. CLIFTON, President, in the Chair.

DR. OBACH described an improved construction of the movable coil galvanometer for determining currents and E.M.F. in absolute measure. This is a more sensitive, accurate, and powerful instrument to the old form. It is intended for accurate measurements and testing other instruments. The needle of the new form does not dip, and its vibrations are rendered dead-beat by an air-chamber. The secants of the inclination of the coil are the multipliers of the tangents of the deflections. The coil consists of a single solid rod or band of copper for measuring powerful currents; and on the same ring is a fine coil of German silver wire for measuring E.M.F. No shunt is required, owing to the movability of the coil. Dr. Obach gave figures showing the accuracy of the apparatus, which is very great.

PROFS. AYRTON and PERRY read a paper on the "*Electric Resistance of Water*," being the results of some experiments made by them some time ago. A comparison of the galvanometer and electrometer methods of measuring this resistance was made during the experiments, the results being in favour of the latter, especially with currents of less than 6 volts. When the electrodes or platinum plates in the water were end-on, the resistance was less than when face to face.

Mr. BOYS thought this curious result might be due to the resistance between the surface of the plates and the water being reduced.

In answer to Dr. COFFIN,

Prof. AYRTON stated that the plates were heated between every two experiments in the blowpipe.

Prof. G. GUTHRIE remarked that Kohlrausch had found ordinary distilled water to be much more conductive than pure distilled water, which was an insulator, and enquired if Prof. Ayrton chose pure water.

The latter replied that his experiments were to test the merits of the galvanometer and electrometer modes of testing.

Prof. JONES stated that he found it best to use alter-

nating currents for measuring the liquid resistance of cells, and described a mercury commutator for rapidly reversing the testing current.

Prof. AYRTON then described a lecture apparatus for showing the laws of centrifugal force. A rapidly rotated arm carrying a movable weight springs from the centre of an aneroid chamber filled with mercury. This chamber is on the rotating axle, and as the centrifugal force of the arm pulls out the diaphragm, the mercury falls in the chamber and in a tube opening from it.

Prof. GUTHRIE remarked that the apparatus would serve as a speed counter.

Prof. PERRY then read a paper on the "*Kinetic Energy of Rotating Bodies*," in which he pointed out the practical drawbacks to the "moment of inertia" calculations, and suggested the use of a new constant (termed for the nonce the "M"). This is the amount of kinetic energy possessed by a rotating body when making one revolution per minute. To find the energy for N revolutions per minute, multiply this by N^2 . In the same way the "M" of a machine can be found and used.

NOTICES OF BOOKS.

Thirteenth Annual Report of the Deputy Master of the Mint, 1882. London: G. E. B. Eyre and W. Spottiswoode.

THE figures contained in this report of the Deputy Master of the Mint show in a highly interesting form all that relates to the production of the coinage of the realm for the past year; and, with the valuable statistics that are also given of the coinages of the principal European Mints, exhibit in a way that cannot fail to give rise to much thought the state of the field occupied by the precious metals as media of exchange.

Although for the year the ordinary business of the Mint has not been so great as usual, activity has been exhibited in other directions by the introduction of several important reforms in the reorganisation of the buildings and machinery, in order to keep the establishment abreast with the times. In the scientific department changes of considerable importance have been made, chief of which is the eviction, by the efforts of Prof. Roberts, of the very ancient and no less cumbersome practice that has existed for centuries of reporting the composition of gold bars in the "carat" system, in transactions with the Bank of England. As this unwieldy unit of weight has been allowed to exist so long in spite of the evidence afforded of the advantages possessed by the decimal system long since adopted in the Continental Mints, it may be of interest to give the following extract from Prof. Roberts's memorandum appended to the Report, showing the reasons that have led to the abolishment of this ancient practice.

The most important question which has received attention relates to the bullion transactions between the Mint and the Bank of England. The composition of gold ingots imported for coinage has hitherto been expressed by the "carat" system; but after careful consideration it has been determined to replace this method of reporting the results of assays by the decimal system already employed in the Australian Branches of the Mint and in foreign countries. The ancient method has survived from the earliest times of which there are Mint records, and is described in the accompanying official letter, suggesting that certain changes in the existing practice should be adopted.

20th July, 1882.

SIR,

I beg leave to submit the following statement as to the method now in use for reporting the results of assays on ingots of gold imported for coinage.

The essential facts are well known, and may be briefly set forth as follows:—

In assaying coin and the bars into which the metal imported for coinage is melted, the result of each assay is expressed decimally, fine gold being taken as the unit of comparison, or as 1000, and the standard prescribed by law for gold coin being 916.6. This system has long been adopted on the Continent and in the Australian Mints, but in this country, side by side with it, a much older one is employed in the Mint, and by jewellers and others. The latter system consists in recording the alloy as being so much "better" or "worse" than standard, and is founded on an ideal unit, the "Carat Pound," which is divided into 24 parts termed carats, British standard gold containing 22 carats of gold and 2 carats of alloy metal in every 24 parts. The carat is further sub-divided into four parts termed "carat grains," and the grain into eight parts, the smallest division of the carat scale being thus the $\frac{1}{8}$ th of a carat grain, or the $\frac{1}{32}$ th part of the carat pound. In order to attain a still greater degree of minuteness, the eighth part of a carat grain is further sub-divided into $7\frac{1}{2}$ parts, or "excess grains." Each of these final divisions is thus the $\frac{1}{256}$ th part of the "carat pound," and, as the Troy pound also contains 5760 grains, each excess grain of gold beyond the last eighth in the assay report is reported as an "excess grain of gold on the Troy pound."

From the point of view of convenience or accuracy in recording the results of the operations of assaying, the carat system is not found to present any difficulty when the operator is familiar with its use. It should further be pointed out that the system is very convenient to those who are accustomed to conduct commercial transactions in the precious metal on the basis of the alloy known as standard gold; but it has the disadvantage of being unintelligible to those who employ the decimal system, and who are therefore in the habit of mentally referring to pure gold as 1000. It is even found wanting in clearness by many who are conversant with the ordinary operations of coinage or bullion transactions. For instance, the meaning of "Worse 0 $1\frac{1}{8} + 1$ " as the assay report of an ingot is at least obscure, while the equivalent statement that the standard fineness of the ingot is 900 at once suggests that 1000 parts of the metal contain 900 parts of gold.

The retention in the Mint of the old system of carats and grains is probably due to the fact that simple tables for calculating the admixture of bullion with the copper required to form standard alloy have been in use at least since the latter part of the 17th century. A set of such tables was published in 1679, having been prepared many years before by Mr. John Reynolds, Assay Master in the reign of James I. From the Mint point of view any belief in the superior convenience of the system may be considered to be based rather upon long usage than upon its merits, and the officers who now conduct the "rating," that is the calculation involved in the conversion of ingots into standard metal, recognise the advantages of, and would gladly use, tables framed on the decimal system.

No suitable tables of this kind at present exist. In the Australian Mints the amount of "alloy" necessary to add to each set of ingots melted in a single crucible is calculated separately, a method of procedure which is out of the question in dealing with the larger transactions of the Mint in this country. A set of tables was published in 1872 by the Deputy Master of the Sydney Mint, but these only show a progressive increase of $100\frac{1}{1000}$ ths, instead of the $100\frac{1}{1000}$ th actually required. I am, however, satisfied that, although the calculation of the necessary tables would involve much labour, it would be possible, before coinage operations are resumed, to interpolate in Mr. Elouis's tables numbers to meet the case of the ingots usually imported for coinage, the fineness of which is comprised within comparatively narrow limits.

It is now admitted as a well-ascertained fact that, while an assay of gold is probably accurate to the

$100\frac{1}{1000}$ th part, the errors are certainly comprised within the limits $\pm 100\frac{1}{1000}$ th part of the piece of metal submitted to assay, or within a range of $100\frac{2}{1000}$ ths. Formerly assays were only reported to the $\frac{1}{8}$ th of a carat grain, or to the $\frac{1}{32}$ th part. Later the Assayers to the Bank of England were instructed to give, in addition to the report expressed in carats and grains, a decimal report to the $100\frac{1}{1000}$ th part. In 1870, however, the Governors of the Bank of England directed that the decimal report expressed to the $100\frac{1}{1000}$ th (the third of a millièrme) should alone be given. So far as I am aware it was urged as a reason for this decision that the process of assaying did not admit of a higher degree of accuracy, and this view was based on the results of a series of assays made by different assayers on the same ingots of gold. The discrepancies in the results justified the views then adopted, but these discrepancies did not depend solely on the limits of accuracy which it is possible to attain in assaying, for, as was pointed out in the "Second Annual Report" (1871), p. 39, when widely divergent results are obtained the gold employed as a check by one or other assayer (in controlling the results afforded by the balance) is probably impure, while the supplementary trial plate made in 1873 constitutes a common standard of reference by which discrepancies might in future to a great extent be avoided. It may perhaps be pointed out that the $100\frac{1}{1000}$ th part is a more minute division than the "excess grain," which is nearly equivalent to $100\frac{2}{1000}$ th parts.

I would suggest, therefore, that the Mint should abandon the system of reporting assays of ingots in carats and grains, and adopt, as in the case of bars and coin, the decimal report expressed to the $100\frac{1}{1000}$ th part, and that the Governors of the Bank of England should be invited to instruct their Assayers to report to the $100\frac{1}{1000}$ th part, the practice of reporting to the $\frac{1}{8}$ rd of a millièrme being discontinued.—I have, &c.,

W. CHANDLER ROBERTS.

The Deputy Master of the Mint.

The ancient system of reporting the results of assays possesses many points of interest, and it may be well to add a few details respecting it, taken from a work by Snelling,* an authority on the computation of the value of bullion, who, writing in 1766, observes that "by the word SILVER we understand not only the metal so-called, pure and unmixed, but also when in a mass with copper; and if but one-half, two-thirds, or any other proportional part of it be silver, yet the whole bears that name. The same is to be understood of GOLD, when by itself or in a mass with silver and copper together, or with either of them alone.

"This is the reason that inquiries are not made, what quantity of fine gold or fine silver is contained in any mixture, which seems to be the most natural inquiry, but how much standard it holds." Thus it is that "the Assay Master, in reporting the result of an assay, does not give the absolute fineness or the quantity of fine silver or fine gold present, but only the relative quantity or fineness, that is, how much the mixture is more or less than standard."

This is the system which has just been displaced in the Mint. Its cumbersome nature will be evident, but it should be pointed out in its defence that, as Snelling proceeds to remark, "the quantity of 'betterness' or 'worseness' in an ingot being added to or subtracted from the weight of it, gives the quantity of standard metal contained in it," and that therefore the "betterness" or "worseness" affords a ready means of determining the amount of copper or gold required to standardise the whole. Further, if a number of ingots of varying weights and fineness have to be dealt with, a similar result will be arrived at by taking the algebraical sum of the several products of their weights and "betterness" or "worseness." These advantages, however, apply to individual

* "Doctrine of Gold and Silver Computations," by Thomas Snelling, London, 1766.

calculations, and become unimportant when standarding tables adapted to the decimal system are available. Such tables have been provided during the past year.

* * Since the above was written, gold of the value of over £2,000,000 has been imported for coinage, and the convenience and accuracy of the system advocated above has been abundantly demonstrated.

From the same Memorandum we take the following extract, which is of historical as well as scientific interest, relating to the accurate estimation of silver by the "wet" and "dry" methods:—

METHOD OF ASSAYING SILVER.

Since 1871 the volumetrical method devised by Gay-Lussac has been used for verifying the composition of bars and coin. It only claims to be a means of verifying the standard of an alloy, and consequently it cannot be applied to alloys the composition of which is not approximately known. It is true that this objection does not apply to the ordinary practice of the Mint, as 'trade assay reports' are furnished either with the ingots or with so little delay that no inconvenience need ensue. The reasons which led to the adoption of the "wet" or verification method in France formed the subject of an elaborate series of papers communicated by M. Thiers to the British Government in 1836.* I have so frequently alluded to its advantages that it may be well to explain why the assay by cupellation was retained in re-organising the Assay Department.

The Commissioners appointed in France in 1829, to investigate the methods of assay then in use, sent alloys of silver and copper, the standards of which were accurately known, to the Assayers of the principal European Mints, including the Mint in this country. The reports of all these Assayers indicated the presence of less silver than the alloys actually contained, the deficiencies varying from 0.2 to 1.0 per cent. The evidence gathered by the Commissioners led them to recommend the adoption of Gay-Lussac's method, and the authority of the Commission, of which the well-known chemists Thénard, Dulong, and Gay-Lussac, were members, discredited the "dry" process on the Continent, and led to its being employed only for obtaining an approximate assay. In this country, on the other hand, the method was retained, carefully devised furnaces and appliances were adopted, and the results of the assays were controlled by an elaborate system of "check assays" on standards of known composition. It is unquestionable that the process has been conducted for centuries in this country with great skill by successive Assayers of the Mint, and, in later years at least, has yielded results which are not merely trustworthy but deserve the highest confidence.

I was anxious that this process, which may be considered to be historical, should be retained for its own sake quite apart from the necessity of employing it whenever the composition of the alloy is not approximately known. The traditional skill in conducting the dry process has, I am satisfied, been well sustained, and all the ingots imported for coinage during the past year have been assayed by its means. Since the close of the year, however, 1097 verification assays of ingots have been conducted by the wet process, and in future either process will be used as special circumstances may require.

Oil of Angelica from the Roots.—Laurent Naudin.—The author concludes that the two terpenes boiling at 158° and at 171° to 175° respectively, mentioned by Beilstein and Wiegand, are merely mixtures of the polymers of the carbide boiling at 166°, modified by the action of sodium and by prolonged ebullition.—*Moniteur Scientifique*.

* "Report of Select Committee of the House of Commons on the Mint," 1837, Appendix, p. 56.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Moniteur Scientifique, Quesneville.
May, 1883.

Part Played by Microbia in Pathology.—M. Boulet.—A purely medical dissertation.

Saccharine Urines.—L. Legrip.—A treatise on the qualitative detection and the quantitative determination of glucose in diabetic urines. As qualitative reagents, he describes bismuth sub-nitrate, caustic alkalies, Trommer's test, sodium sulphindigotate, ammoniacal silver nitrate, and ferric hydroxide. He also mentions the fermentation process, and the separation of sugar in a crystalline form, which is not in all cases practicable. Among quantitative procedures, he condemns the fermentation method. He gives several modifications of Fehling's method, as also those of Millon and Commaille, and of Sachsse.

Law of the Congelation of Aqueous Solutions of Organic Matters.—F. M. Raoult.—It has been previously shown by Blagden and Rüdorff that the freezing-point of a liquid is lowered proportionately to the weight of one and the same salt dissolved in a constant weight of water. M. de Coppet has further shown that the specific lowerings of the congelation-point of certain salts are almost inversely proportional to the respective molecular weights of these salts. M. Raoult has extended these observations to organic substances. He finds that the lowering of the congelation-point is proportional to the weight of the substance dissolved in the water, provided that the lowering does not exceed 2°. If the lowering of the congelation-point, referred to 1 grm. of the substance dissolved in 100 grms. of water, is multiplied by the molecular weights of the substance, the result is approximately constant.

Cause of the Colour of Precious Stones.—Col. W. A. Ross.—From the *Proceedings of the Royal Society*.

The Properties of Pure Metallic Aluminium.—J. Mallet.—From the *CHEMICAL NEWS*.

Contribution to the Study of the Tungsten Compounds.—G. von Knorre.

Notice on Barium Hydroxide on the Haloid Salts of Barium and on Basic Barium Chloride, Bromide, and Iodide.—E. Beckman.—From the *Journal für Praktische Chemie*.

Electrolytic Separation of Metals.—From the *CHEMICAL NEWS*.

New Method of Manufacturing Sodium Sulphide.—W. Weldon.—From the *Journal of the Society of Chemical Industry*.

Utilisation of Nitrogen Compounds lost in the Manufacture of Sulphuric Acid.—J. Wachtel.—The author proposes to aspirate the gases through a cast-iron retort, filled with iron turnings, and heated to redness. The hydrogen liberated by the reaction of watery vapour reduces the oxides of nitrogen, forming ammonia, which is then absorbed in sulphuric or hydrochloric acid.

Density of Monohydrated Sulphuric Acid.—A. Schertel.—From the *Journal für Praktische Chemie*.

Use of Dehydrated Oxalic Acid for Preparing Normal Acidimetric Liquids and Standard Permanent Solutions.—Professor W. Hampe.

Detection of the Eosine Colours.—Rudolf Benedikt.—Already inserted.

Extraction of Cellulose from Wood.—R. Mitscherlich.—The author treats the wood, &c., suitably comminuted, with calcium sulphite under pressure. The

cellulose is then separated from the soluble matters by means of a filter-press, and after washing is fit for paper-making.

Composition of the Water which escapes from the Petroleum Wells of the Caucasus.—A. Potilizin.—The waters in question are remarkably rich in sodium iodide and bromide.

Dephosphorisation Slags used as Manure.—The slags contain as much as 19 per cent phosphoric acid. They should be used simply ground, rather than rendered soluble by means of sulphuric acid.

Mineral Colours with Tungstic Acid.—By the double decomposition of a soluble tungstate with metallic salts there are obtained coloured precipitates capable of being used as pigments. Nickel tungstate is a light green, chrome tungstate a deep green, cobalt tungstate a violet or indigo blue, barium tungstate a fine white body colour, and free tungstic acid a light brilliant greenish yellow.

History of China cuprea.—O. Hess.—This memoir is mainly of pharmacological interest.

Researches on Gelsemine.—S. W. Gerrard, F.C.S.

Physiological Action of Gelsemine.—Dr. G. Rauch.

Action upon the Eye.—Prof. J. Tweedy, F.R.C.S.—These three papers appear to be from an English source.

The Preparation of Quinoline.—R. Bourcart.—The process given is a modification of that of Skraup.

New Electric Apparatus for Preventing Boiler Explosions.—The apparatus, which is not described, registers automatically the level of the water in the boiler.

Incombustible Paper, Ink, and Colours.—The paper consists of asbestos; the inks and colours are made of coloured earths, such as umber, Sienna, &c., ground up with glycerin and solutions of soluble silicates.

Certain Azo-Derivatives.—Ch. Girard and A. Pabst.—The diazo-derivative of sulphanilic acid yields yellows with dimethylaniline, resorcline, and α -naphthol, and oranges with β -naphthol and diphenylamine. Methyl-resorcline gives likewise a yellow-orange. On combining diazo-phenyl-sulphurous acid with pyro-gallol-sulphurous acid, there is obtained a deep orange, somewhat fugitive, transparent, and which does not cover the fibre well. Cresylol gives in the same manner an orange. With methyl-diphenylamine we have a fine deep orange, differing little from that derived from diphenylamine; methyl-dixylidine gives an orange-scarlet, and methyl-dinaphthylamine an orange-red. Naphthylamine sulphurous acid furnishes, in the same manner, a diazo-derivative, which, with methyl-diphenylamine produces a scarlet-red. Analogous shades are obtained with benzyl-diphenylamine, dixylidine, methyl-dixylidine, dinaphthylamine, cresyl-naphthylamine, methyl-dinaphthylamine, ethyl-diresylamine (liquid or solid), and amyl-diphenylamine. These shades vary from scarlet to crimson. Diazo-dinitro-phenol obtained from picramic acid gives, with resorcline, a garnet-red, passing quickly to a maroon, and probably undergoing decomposition; the ammoniacal solution is a garnet-red, and dyes fibres a reddish maroon. With methyl-resorcline we have a fine garnet-red, and with the sulpho-conjugated compound of dimethyl-resorcline a reddish brown. Phenol gives a dirty orange-brown; methyl-naphthol, a violet; amido-azo-naphthaline, an intense brown; and gallic acid, a fine yellow-brown. Cœruleine combines with difficulty, giving a dirty green, and eosine a fine brown. Sodium alizarine sulphite gives a green-brown, slightly dichroic; rosaniline sulphite, a garnet-brown, also dichroic; and anthraquinone sulphite, a green-brown, verging upon an olive. Phthalic acid and phthalimide give a dull, transparent, yellowish brown. Methyl-diphenylamine produces in alkaline solutions an orange-brown, but, in presence of acetic acid, a bronze-brown. With oximido-naphthol the authors have obtained a very fine brown. Picric and picramic acid yield oranges which are brownish, dirty, and transparent. The

azo-compounds have the less colouring-power the more symmetrical is their molecule. The introduction of a sulpho-conjugated group turns their shade to a yellow-orange, whilst additions of methyl in a phenolic or amidic function modifies the shade slightly towards a red.

Journal für Praktische Chemie.

New Series, Vol. xxvii., Nos. 4 and 5, 1883.

Saturation-Capacity of the Elements, especially of Sulphur.—C. W. Blomstrand.—This important paper is unfortunately too long for reproduction.

Ethylene Ethers of the Nitro-phenols and of the Oxybenzoic Acids.—Dr. Edmund Wagner.—We find here an account of ethylen-dinitro-phenyl-ether, ethylen-diortho-amido-phenyl-ether, ethylen-diortho-amido-phenyl-ether hydrochlorate, diacetyl-ethylen-diortho-amido-phenyl-ether, ethylen-dipara-amido-phenyl-ether and its salts, ethylen-dimeta-amido-phenyl-ether, ethylen-phenol-para-oxybenzoic acid, ethylen-nitro-phenol-oxybenzoic acids, their ethers and salts.

Chemical Dialysis with the Application of Chloroform, Water, or Ether, and its Significance for the Analysis of Vegetable and Animal Albumenoids.—H. Struve.—The author ascribes the imperfect success which has attended dialytic researches on the albumenoids to three causes,—the instability of the substances, the use of parchment paper, and the difficulty of examining the substances which pass through the dialyser. To meet the first difficulty, of which all experimentalists have been aware, the operation has always been carried out at the lowest practicable temperature, as quickly as possible, and with frequent renewal both of the external liquid and of the parchment paper. Everyone who has undertaken dialytic experiments knows the difficulty of meeting with a good parchment paper of uniform quality. The author considers that the distinction between colloid and crystalloid substances, as proposed by Graham, cannot be maintained. For the membrane he selects the bladders of animals. He softens them in water, frees them mechanically from fat as completely as possible, and then treats them repeatedly with ether. Bladders thus prepared and submerged in ether retain their good qualities for years. For the external fluid he recommends water which has been shaken up with an excess of chloroform, and allowed to separate on standing. It prevents, or at least retards, chemical changes in the substances operated upon.

Studies on Milk.—H. Struve.—The author comes to the conclusions that human milk and cows' milk contain the identical albumenoids. Human milk contains, however, a smaller proportion of albumenoids, and especially of caseine. All the albumenoids held in solution in milk can be separated by dialysis (with chloroform water) from the undissolved caseine and from the butter. A part of the undissolved caseine forms the covers of the milk-globules, and is separated out in the cream; the other portion remains in the skim-milk. The milk-globules swell up if shaken with ether. The digestibility of any milk is inversely as the quantity of caseine which remains in the skim-milk. Hence Dr. Biedent's suggestion that only cream should be used for the earliest nourishment of young children brought up by hand is perfectly justified. The caseine of human milk, as well as of cows' milk, has always an acid reaction. In human milk there is only a small quantity of butter in a free state.

Journal de Pharmacie et de Chimie.

Tome vii., May, 1883.

Chemical Study of the Globulariæ.—MM. Heckel and Schlagdenhauffen.—This paper has more of a pharmaceutical than of a strictly chemical character.

Specimen of Cinchona succirubra Grown in the Conservatories of the Faculty of Medicine.—MM. J. Regnault and Villejean.—The authors admit that the facts mentioned in their paper are not of great interest.

Alumed Wines.—P. Carles.—It appears that alum is sometimes added to wines to give astringency and to raise the colour. For its detection it is necessary to evaporate to dryness and destroy the organic matter by ignition.

The Ptomaines before the Tribunals.—L. Garnier.—The author points out as a characteristic symptom produced by the ptomaines the loss of cutaneous sensibility and of muscular contractility, even under electric excitement, which are produced by no vegetable poison except muscarine. The reduction of potassium ferricyanide is characteristic only in the absence of morphine, apomorphine, veratrine, hyoscyamine, and muscarine. Their physical form is in most cases amorphous or indistinctly crystalline. Their separation from the true alkaloids is a matter of extreme difficulty if the analysis is not undertaken immediately after death. In spite of the use of the successive solvents indicated by Dragendorff, and the ultimate transformation of the extracts into crystalline salts, we always obtain alkaloids more or less mixed with ptomaines, and giving the reaction with ferricyanides. Hence it is necessary to determine all the characters of the body isolated, and to compare the results obtained with the known reactions of the substance which we suppose we have in view.

Researches on the Passage of Alcoholic Liquids through Porous Bodies.—H. Cal.—Already noticed.

Comparison between Different Kinds of Gluten Bread.—A. S. Mallat.—A determination of the proportion of starch in various breads recommended for diabetic patients.

Analysis of a Verdigris sophisticated with Blue Sand.—M. Astre.—The specimen contained 10 per cent of sand coloured blue by means of Prussian blue.

Spontaneous Destruction of Oxalic Acid.—G. Fleury.—Standard solutions of oxalic acid containing 4 to 6 decigrams per litre ceased to present an acid reaction. Large flocks of a cryptogamous vegetation had been developed similar to those which appear in solutions of tartaric acid. No similar change took place, even in four years, in standard solutions containing 6.3 grms. oxalic acid per litre. The bottles containing the weak solutions had been unstopped only once or twice.

Detection and Determination of Benzoic Acid in Milk.—M. Meissl.—The author takes 250 to 500 c.c. of the milk, renders it alkaline with a few drops of lime, or baryta-water, evaporates down to one-fourth, adds calcium sulphate, and dries on the water-bath. He then adds more calcium sulphate and a few drops of baryta-water, pulverises finely, mixes it with dilute sulphuric acid, and stirs up in double its volume of alcohol at 50 per cent, which dissolves benzoic acid whilst taking up only the very slightest traces of fats. The liquid thus obtained, which, besides the benzoic acid, contains milk-sugar and inorganic salts—is neutralised with baryta-water, and evaporated down to a small bulk. It is acidified with dilute sulphuric acid, and shaken up with a small quantity of ether, which on evaporation leaves pure benzoic acid. To effect the quantitative determination the residue is dried at 60°, weighed: the benzoic acid is driven off. On weighing again the benzoic acid is found as loss.

Researches on the Presence of Formic and Acetic Acids in Plants, and on the Physiological Part Played by these Bodies.—E. Bergmann.—These acids occur in the protoplasm of all the plants examined. They are found both in the colourless cells and in the green tissues, and must be considered as constant products of the transformation of the proximate principles. It is probable that several other acids of the fatty series, such as the propionic, butyric, capric, &c., are equally diffused in the

vegetable kingdom. The quantity of the volatile acids increases in plants grown in darkness, whence they are products of regressive metamorphosis.

Preservative Action of the Vapours of Ether and Chloroform upon Organised Substances.—R. Dubois.—Of interest to the anatomist.

Presence of Copper in Cereals, Flour, Bread, &c.—M. Galippe.—Copper exists normally, in larger or smaller proportion, in plants, and especially in wheat. It exists in bread without having been fraudulently introduced.

Some New Metallic Derivatives of Taurine.—M. Guerin.—The author describes taurine cupro-ammonium, taurine zinc-ammonium, and taurine sodium chloroplatinate.

Researches on the Hyponitrites.—MM. Berthelot and Ogier.—From the *Comptes Rendus*.

Bulletin de la Société Chimique de Paris.
No. 10, May 20, 1883.

The Double Orthophosphates of Barium and Potassium and of Barium and Sodium.—A. de Schulten.—The author obtains the former of these compounds by mixing a solution of potassium silicate with baryta-water, heating it to a boil, and then adding a solution of potassium silicate containing in solution potassium phosphate. The sodium compound is obtained in an analogous manner. The quantities of phosphate and of baryta-water must be small in proportion to the silicate.

On Certain Properties of Normal Camphor Monochloride.—P. Cazeneuve.—The author studies here the behaviour of the camphor compound with hydrogen, soda-lime and quicklime, alcoholic potassa, and sulphuric acid.

Action of Fuming Nitric Acid upon Camphor Monochloride.—P. Cazeneuve.—On causing four parts of hot fuming nitric acid to act upon one part of the camphor compound, the author obtains, among oxidation and destruction products, a chloro-nitro compound answering to the formula $C_{10}H_{14}Cl(NO_2)O$, essentially analogous to the bromo-nitric compound of R. Schiff.

Russian Chemical Society, Session of September 16th/28th, 1882.

M. Mestchersky sent a memoir on the salts of bismuthic acid. He has not succeeded in obtaining barium bismuthates of constant composition.

MM. Lidoff and Tischomiroff have continued their researches on the action of the electric current upon the chlorates. On employing carbons as electrodes the authors find that the decomposition of the alkaline chlorides is not complete, and is always accompanied by a decrease of the weight of the positive carbon. On the other hand, on causing the current to act upon a chlorate, the weight of the carbon diminishes immediately, the chlorate being converted into chloride. When using a positive pole of platinum the authors find that the chlorate is decomposed into a chloride and ozone.

M. Lidoff gave in a memoir on the coke of petroleum. It is purer and harder than that of coal, more compact, and burns with more difficulty. For the electric light and for the manufacture of electrodes it is superior to ordinary coke.

M. Potilitzine sent in a memoir on the composition of petroleum, and of those which are ejected by the mud-volcanoes of the Caucasus.

M. Dianine finds that the oxidation of phenol by permanganic acid gives rise to a phenol identical with that obtained by Engelhardt and Latchinoff.

M. Grigorieff sent in an analysis of certain springs at Moscow, and an account of certain new deposits of a mineral manure.

M. Menschutkine described his researches on the decomposition of tertiary amyle acetate by heat.

MEETINGS FOR THE WEEK.

WEDNESDAY, 20th.—Meteorological, 7.
Geological, 8.
THURSDAY, 21st.—Royal, 4.30.
Royal Society Club, 6.30. (Anniversary.)
Chemical, 8. Ballot for the election of Fellows.
"On Evaporation *in vacuo*," by Prof. H. McLeod.
"Note on Hydrocarbons from Camphor," and
"Note on some Substitution Derivatives of Camphor," by H. E. Armstrong. "On the Decomposition of Ammonium Nitrate; an Investigation into the Rate of Chemical Change," by V. H. Veley.
FRIDAY, 22nd.—Quekett Club, 8.
SATURDAY, 23rd.—Physical, 3. "Researches upon the cause of Evident Magnetism and Neutrality in Iron and Steel, Illustrated by Experiments," Prof. Hughes.
"A Sine Electrometer," by Prof. G. W. Minchin.
"Induction Balance Effect and Densities of Alloys of Copper and Antimony," by Mr. G. Kamensky.

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Wanted, Assistant Chemist: one accustomed to Sugar, Glucose, and Starch Products preferred.—Apply J. T. Armstrong, Victoria House, Newcastle, Staffordshire.

Wanted, Chemist acquainted with manufacturing by the ammonia-soda process; knowledge of engineering desired; no subsisting agreements on the part of the applicants need stand in the way; salaries large.—Communications strictly confidential, to S., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, Chemist at a large Works in Lancashire: one acquainted with the manufacture of oleine and indigo extract preferred. Salary, £150.—Communications, strictly confidential, to W., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

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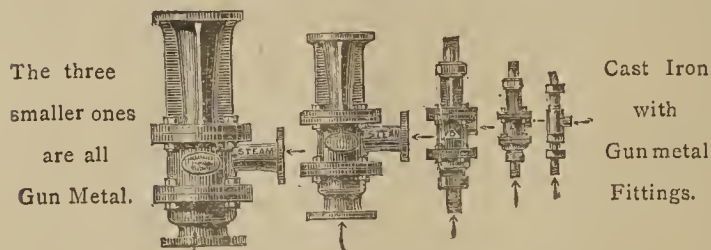
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1230.

ON THE DETECTION OF UREA IN AN AQUEOUS SOLUTION.

By C. L. BLOXAM.

A WEAK solution of urea or its nitrate in water presents a difficult problem to the analyst. I have found the following methods very useful in solving it:—

Cyanuric Acid Test.—Ascertain, by testing for nitric acid, whether the nitrate is to be suspected; if so, mix the solution with a few drops of solution of NH_4Cl ; but if no nitric acid be found, acidify the solution with HCl . Evaporate the solution on a porcelain crucible lid, or on a glass slide, and heat the residue as long as it continues to evolve *thick* white fumes. Dissolve the cooled residue in a drop or two of NH_3 , add a drop of BaCl_2 , and stir with a glass rod. If urea had been present, a crystalline precipitate of barium cyanurate will be formed on the lines of friction made by the rod upon the glass slide.

A very characteristic test for the cyanuric acid consists in dissolving it in a drop or two of ammonia, and adding a drop of a weak solution of cupric sulphate. On standing for a few minutes, a violet coloured crystalline precipitate separates. If the experiment be made on a crucible lid, this precipitate collects in the angle of the lid, when the latter rests obliquely on the table, and a very small quantity becomes perceptible. The precipitate appears to be the cyanurate of cuprammonium described by Wöhler, and is seen under the microscope to consist of very definite rhomboidal plates of a fine red-violet colour.

King's College, London, June 15, 1883.

ON A NEW METHOD FOR THE ESTIMATION OF MINUTE QUANTITIES OF CARBON, AND A NEW FORM OF CHROMOMETER.*

By J. E. STEAD, Middlesborough.

PART I.—ESTIMATION OF MINUTE QUANTITIES OF CARBON.

As is well known, it is impossible to determine with accuracy minute quantities of carbon by the ordinary colour method, owing to the colour of the nitrate of iron present, which interferes so as to make it impossible to judge of the colour due to carbon.

Having been engaged in some careful investigations on the nature of the colouring matter which is produced by the action of dilute nitric acid upon white iron and steel, it was found it had the property of being soluble in potash and soda solutions, and that the alkaline solution had about two and a half times the depth of colour possessed by the acid solution. This being so, it was clear that the colour matter might readily be separated from the iron, and be obtained in an alkaline solution, by simply adding an excess of sodium hydrate to the nitric acid solution of iron, and that the colour solution thus obtained might be used as a means of determining the amount of carbon present. Upon trial this was found to be the case, and that as small a quantity as 0.03 per cent carbon could be readily determined.

The method as now in use is conducted as follows:—

Standard solution of nitric acid, 1.20 sp. gr.

Standard solution of sodium hydrate, 1.27 sp. gr.

* A Paper read before the Iron and Steel Institute.

One gramme of the steel or iron to be tested is weighed off and placed in a 200 c.c. beaker, and, after covering with a watch-glass, 12 c.c. of standard nitric acid are added. The beaker and contents are then placed on a warm plate, heated to about 90° to 100°C. , and there allowed to remain until dissolved, which does not usually take more than ten minutes. At the same time a standard iron containing a known quantity of carbon is treated in exactly the same way, and when both are dissolved 30 c.c. of hot water are added to each, and 13 c.c. soda solution.

The contents are now to be well shaken, and then poured into a glass measuring-jar and diluted till they occupy a bulk of 60 c.c. After again well mixing and allowing to stand for ten minutes in a warm place, they are filtered through dry filters, and the filtrates, only a portion of which is used, are compared. This may be done by pouring the two liquids into two separate measuring-tubes in such quantity or proportion that upon looking down the tubes the colours appear to be equal.

Thus if 50 m.m. of the standard solution is poured into one tube, and if the steel to be tested contains say half as much as the standard, there will be 100 m.m. of its colour solution required to give the same tint. The carbon is therefore inversely proportional to the bulk compared with the standard, and in the above assumed case, if the standard steel contained 0.05 per cent carbon, the following simple equation would give the carbon in the sample tested:—

$$\frac{0.05 \times 50}{100} = 0.025 \text{ per cent.}$$

Experiments were made upon a steel which contained 0.11 per cent carbon to ascertain what the influence would be of heating the nitric acid solution for an increasing length of time after dissolving on the bath.

For this purpose five separate portions of the steel were weighed off, and each treated with 12 c.c. nitric acid. The iron in all was completely dissolved in five minutes. One portion was at once taken off and treated with water and soda. A second portion was allowed to remain ten minutes on the bath, a third fifteen minutes, a fourth twenty minutes, and the last twenty-five minutes. Each portion when removed from the bath was treated as before described, and when all the clear colour solutions were obtained they were carefully compared, with the following results:—

Carbon—

5 minutes.	10 minutes.	15 minutes.	20 minutes.	25 minutes.
0.098 p.c.	0.110 p.c.	0.110 p.c.	0.110 p.c.	0.108 p.c.

From this it will be seen that the carbon colour is not materially affected by heating the acid solution twice as long as is necessary for completely dissolving the carbon compound, and that, although the iron is dissolved in five minutes, it is evident that some of the carbon compound at first formed escapes solution in that period.

The next point was to ascertain what effect the use of an excess of nitric acid in dissolving the steel would have on the colour matter.

To determine this, five separate portions were treated respectively with 12, 15, 18, 21, and 25 c.c. of nitric acid, and heated for ten minutes on the bath; after which they were all treated with water and an excess of soda solution, and, after filtering, the clear filtrates were compared, with the following results:—

Carbon—

12 c.c.	15 c.c.	18 c.c.	21 c.c.	25 c.c.
0.41 p.c.	0.41 p.c.	0.41 p.c.	0.402 p.c.	0.380 p.c.

From which it is seen that 6 c.c. acid in excess does not materially affect the determination, but when this is exceeded the colour is reduced in quantity.

It now became important to know if a greater or less

quantity of soda solution would have a different solvent power on the colouring matter.

To ascertain this, four separate portions of the soft steel were treated alike in dissolving, but to the solutions different quantities of soda solution were added.

The following results were obtained, viz.—

Sodium Hydrate.

	13 c.c.	15 c.c.	18 c.c.	21 c.c.
Carbon ..	0.110 p.c.	0.110 p.c.	0.110 p.c.	0.115 p.c.

Here it will be seen that, as before stated, 13 c.c. sodium hydrate solution is capable of effecting solution of the colouring matter. By using a less amount, however, by experiment it was found that the colour is precipitated with the iron oxide.

It is very well known that in the old acid colour method very slight traces of hydrochloric acid, if present, alter the character of the colour to such an extent as to make the colour determination unreliable. It therefore was of interest to ascertain if the same would occur in the alkaline method. Four portions of steel were treated as usual, excepting that to one portion a single drop of hydrochloric acid was added when being dissolved, to a second five drops, and to a third ten drops, but to the last portion no hydrochloric acid was added.

The following are the results obtained, viz.—

Hydrochloric Acid.

	1 drop.	5 drops.	10 drops.	None.
Carbon ..	0.105 p.c.	0.090 p.c.	0.078 p.c.	0.110 p.c.

Second Test.

	1 drop.	5 drops.	10 drops.	None.
Carbon ..	0.356 p.c.	0.338 p.c.	0.324 p.c.	0.410 p.c.

The colour in each case, and even in that in which the larger quantity of hydrochloric acid was added, was the same in quality, although differing in quantity, showing (1) that the presence of chlorides is harmless, and (2) that nitro-hydrochloric acid, even in small quantities, prevents the formation of the full amount of colour matter capable of being produced by nitric acid alone.

A large number of samples of low carbon iron have been examined by the alkaline method, including samples of iron taken from the Bessemer converter at the end of the blow before any addition of spiegeleisen. The results are likely to be of interest to many members present, and I therefore give them here:—

Blown Iron taken from the Bessemer Converter.

No. 1	0.040 p.c. carbon.	
No. 2	0.036 "	
No. 3	0.045 "	
No. 4	0.039 "	
No. 5	0.061 "	
No. 6	0.048 "	
Average	0.045 "	
Average by combustion	0.048 "	
	New Colour Method.	Combustion.
Standard soft steel ..	0.120 p.c. carbon.	0.122 p.c.
Pure iron wire	0.038 "	
Cleveland iron ship plates	0.055 "	—
Ditto ditto	0.035 "	—

The colour solutions from these low carbon irons are different in tint from those obtained from the higher carbon steels, and it is important that a low carbon iron be used as a standard for comparison.

When high carbon steel is heated to redness and chilled, it is well known that the colour from the chilled steel is very much less in quantity than that from the same steel before hardening. The difference, however, is

not nearly so marked when there is little carbon present in the steel, as was proved by the following results, viz.:—

Several samples of iron and steel after being drilled were heated to redness and chilled in water, the results before and after being as follows:—

		Difference.
Soft steel = soft	0.168 p.c.	
" chilled in cold water ..	0.158 "	0.010 p.c.
" chilled in hot water ..	0.168 "	
Staffordshire square iron bar ..	0.110 "	0.010 "
" " " chilled ..	0.100 "	
" flat " " ..	0.069 "	None.
" " " chilled ..	0.069 "	
Soft steel	0.077 "	0.006 "
" chilled	0.071 "	

It is not often that soft iron or steel is chilled before being placed in the hands of the analyst, but it is satisfactory to know that even if they were, the results by colour would not be rendered useless.

When using the new method, I have found that some steels give a much yellower colour than others, and in course of investigation have discovered that there are present in all nitric acid steel solutions two distinct colouring-matters, which I have separated and obtained in a nearly pure state, one of which is bright yellow, resembling potassium chromate, the other being of a dark brown-red colour. In some steel solutions the yellow colour preponderates, and in others the brown.

I expect and hope that the investigations I am working at will eventually throw some light on the true constitution of hard and soft steel, and I trust also that before long I may have the pleasure of bringing their results before you.

PART II.—A NEW FORM OF CHROMOMETER.

In comparing colour solutions there are two methods of procedure. The first is that generally adopted in making determinations of the carbon by the acid colour process, in which the darker solution is diluted with water until the colours of the two solutions are equal in density—that is to say, until the colour is equal per cubic centimetre. The diluted volume is then noted, and the amount of carbon read off in 0.1 per cent per c.c. In the alkaline method it is better to use the second method, already described in this paper, of comparing directly the relative density of the colour solution without dilution, and ascertaining the lengths of the two columns of liquids, which, when examined from the surface, give the same depth of colour. The carbon in this process is, as compared with the standard, inversely proportional to the length of the liquid column.

If a fixed length of liquid column be used of the solutions of carbon and a variable standard column, then, by using a suitable standard solution, the carbon may be deduced from the length of the latter required to make a colour column equal in depth to the former and the percentage read directly from a graduated scale. The instrument I have arranged is made on this principle; it is extremely simple and easily constructed. It consists of two parallel tubes, which may be of any suitable diameter, one of which is contracted at a point 9 inches from the top, and is open at both ends. The lower end passes through an india-rubber cork to the bottom of a 4-oz. bottle, which contains the standard colour solution. A second tube of smaller diameter also passes through the cork into the bottle, the outside end of which is in communication with a large syringe.

Just above the contracted part of the first-mentioned tube a small glazed cylinder of china clay rests. By pressing the syringe the liquid can be forced from the bottle below up this tube. The second tube is about 9 inches long, and is closed at the lower end. At this end a small glazed clay cylinder is also placed. When this tube is placed parallel to the first, the length from the open upper ends to the flat surfaces of the clay prisms

is equal in each. A small looking-glass at an angle of 45° is fixed above the open ends of the tubes, and the standard tube is graduated into 0.01 part to 0.15 part.

The method of working with the apparatus is very simple. The colour solution to be compared is placed in the second tube, with which it is filled up to a certain fixed mark.

It is only now necessary to squeeze the syringe and force the liquid up the first tube until the colours in the two columns are equal, as can be seen by looking into the mirror above. The height of the standard solution is read off on the graduated scale, which will be the percentage of carbon in the steel or iron under examination.

THE ANALYSIS OF ENSILAGE MADE FROM A POOR QUALITY OF GRASS.

By FRANCIS SUTTON, F.I.C., F.C.S.

A CONSIDERABLE number of analyses of ensilages made from maize, rye, Italian rye grass, &c., have been published, but I am not aware that up to the present any experiments, either practical or chemical, have been made on common mixed grass such as is here examined. The hay No. 1 and its corresponding ensilage were made from grass growing naturally in a wood from which the trees had been partially cleared. Some years ago no seed of any kind was ever sown: previous to 1882 the grass was given away to anyone who would take the trouble to cut it for litter, the quality being very coarse and rank.

The hay No. 2, with its corresponding ensilage, were made from common mixed grasses growing in a rough meadow, and naturally of a poor, coarse description, though certainly better than No. 1. At the same time, it had no pretension to the quality of grass such as is necessary for the production of fine meadow hay.

I am indebted to Lord Walsingham, of Merton Park, Norfolk, for the opportunity of examining these samples

of hay and ensilage; but the real work of designing and carrying out the ensilaging process, and the subsequent feeding experiments, is due to Mr. Henry Woods, his lordship's agent,—a gentleman who has made his name known throughout the world as a most active and intelligent agriculturist.

The chemical examinations were made with the utmost care, and in all important points were checked by duplicate estimations. The processes generally used for the examination of vegetable products of this description are no doubt familiar to most chemists, and therefore need no detailed description. It is necessary, however, to say that in the case of the ensilages no actual sugar occurs in the aqueous extract. Digestion with acid for some hours produces a substance which readily affects the copper reaction, but I have not yet been able to determine the nature of the sugar so produced. The hay made from the same grasses does yield a trace of ready-formed sugar, and this again is considerably increased by digestion with acid. Fine quality of hay, as is well known, contains a large proportion of sugar. I am inclined to think that ensilages from almost all fodder plants, if cut at the proper stage and well stored, are destitute of ready-formed sugar.

Report on the Analyses of Hay and Ensilage.

The two samples of hay consisted of a variety of grasses, many of them of a coarse description and of poor quality, and were destitute of the sweet smell and taste which always accompanies well-made meadow hay of good quality.

The texture of No. 2 was, however, preferable to No. 1, and the grass of a somewhat finer description.

Both specimens of ensilage were, on the contrary, highly odoriferous from the development of the essential oils peculiar to the various grasses, and had also a vinous smell, accompanied with a slight but pleasant acidity.

The smell of essential oils was so persistent that after handling the ensilage for some time it became very difficult to remove the smell by washing. On distilling some

Analysis of Two Samples of Hay and Two Samples of Ensilage.

GENERAL COMPOSITION.

	Natural State.				Dried at 212° Fahr.			
	Hay. No. 1.	Hay. No. 2.	Ensilage. No. 1.	Ensilage. No. 2.	Hay. No. 1.	Hay. No. 2.	Ensilage. No. 1.	Ensilage. No. 2.
Water	22.20	24.90	74.30	65.95	10.55	13.00	24.28	27.00
Soluble organic matter..	8.21	9.75	6.24	9.17	5.20	4.20	6.92	5.55
Soluble inorganic matter ..	4.05	3.15	1.78	1.88	78.50	77.85	65.80	65.05
Insoluble organic matter ..	61.04	58.50	16.91	22.18	5.75	4.95	3.00	2.40
Insoluble mineral matter ..	4.50	3.70	0.77	0.82	100.00	100.00	100.00	100.00

DETAILED COMPOSITION.

	Natural State.				Dried at 212° Fahr.			
	Hay. No. 1.	Hay. No. 2.	Ensilage. No. 1.	Ensilage. No. 2.	Hay. No. 1.	Hay. No. 2.	Ensilage. No. 1.	Ensilage. No. 2.
Water	22.20	24.90	74.30	65.95	10.55	13.00	24.28	27.00
Albumen and protein substances, soluble in water*	0.73	0.88	1.60	2.12	0.94	1.17	6.22	6.23
Insoluble protein compounds**	5.03	7.09	1.41	1.43	6.46	9.45	5.49	4.20
Sugar, gum, and extractive matter, soluble in water ..	7.48	8.87	4.64	7.05	9.61	11.85	18.06	20.73
Oil, wax, chlorophyll, &c. ..	1.29	1.34	0.72	0.89	1.54	1.80	2.80	2.60
Digestible fibre	20.80	19.80	8.28	10.62	26.73	26.35	32.24	31.17
Indigestible woody fibre ..	33.92	30.27	6.50	9.24	43.74	40.25	25.26	27.14
Soluble inorganic matter ..	4.05	3.15	1.78	1.88	5.20	4.20	6.93	5.53
Insoluble mineral matter ..	4.50	3.70	0.77	0.82	5.78	4.93	3.00	2.40
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Containing nitrogen	0.115	0.140	0.255	0.336	0.149	0.186	0.992	0.990
**Containing nitrogen	0.755	1.120	0.221	0.226	1.020	1.490	0.860	0.665
Total percentage of nitrogen .	0.910	1.260	0.476	0.562	1.169	1.676	1.852	1.655
Equal to total protein compnds.	5.760	7.970	3.010	3.557	7.400	10.630	11.72	10.470

of the material with water these essential flavours were carried over into the distillate, but, though powerful, the quantity of actual oil was too small to be separated.

The hay treated in precisely the same manner gave no trace of essential oils, or any flavour whatever except that of decaying grass.

In addition to the detailed analyses recorded in the Tables, the ensilages Nos. 1 and 2 were both examined for the amount of acidity; this was found to be very much the same in both samples, and taking it as acetic acid, the proportion was found to be respectively 0.34 and 0.36, or about one-third of a per cent.

The alcohol was estimated in No. 2 ensilage, and amounted to 0.055 per cent by weight, or about one-tenth of a per cent of proof spirit.

These proportions are very small, and they arise of course from the conversion of a small proportion of saccharine matter in the original grass, but their development is open to no objection when kept within moderate limits; on the contrary, they add to the fragrant and taste of the substance, and undoubtedly render it more acceptable, and probably more digestible, as a food.

If the effects of the silo were only to render what would otherwise be a tasteless, dry forage into a fragrant, appetising, and succulent food, it would be a decided step in advance; but the analyses will show that much greater changes of a beneficial nature occur during the process. These changes are especially shown in the large proportions of soluble flesh formers and fat producers as compared with the hay.

For instance, in the case of No. 1 ensilage, the soluble albumenoids (or flesh formers) are increased more than six times, and in No. 2 more than five times; while in the case of sugar, gum, and extractive matters the proportion is nearly doubled in both instances.

The digestible fibre is also increased fully 20 per cent in both samples of ensilage.

These facts are of great importance and well worth the attention of all stock-feeders, as it is evident that the occurrence of these nutritious constituents in a readily soluble form is so much labour of mastication and digestion saved to the animals who are fed on such food as compared with dry hay.

The change induced by the silo is, in fact, a partial digestion or limited fermentation, and undoubtedly such food will prove much easier of digestion and assimilation than crude hay.

There are apparently two anomalies in the figures of analysis which it may be proper to notice. The first is the apparent increase in fatty matters in the ensilages as against the hays; this probably arises from matters like chlorophyll, &c., which are converted into a less soluble form in the process of drying through which the hay has passed.

The second is in the amount of nitrogen found in No. 1 ensilage as compared with its hay.

The total protein compounds (flesh formers) are recorded as being 4 per cent higher. This can hardly be the fact, as, of course, the silo has no power to originate nitrogenous constituents; it can only modify them. The difference probably arises from one of two things—either that the sample of ensilage taken for analysis contained rather more of the seed vessels, or other richer nitrogenous portions of the plant, than the corresponding sample of hay, or it may be due entirely to the different periods of growth.

In conclusion, it is abundantly evident, so far as these analyses can show, that the silo has produced a succulent, easily-digestible food, full of aroma and nutrition, from a very poor quality of grass.

Destruction of Bricks.—M. Parive traces the disintegration of bricks to a microscopic organism, the action of changes of temperature being merely secondary.
—*Cosmos les Mondes*.

ON THE APPLICATION OF HYDROGEN PEROXIDE IN CHEMICAL ANALYSIS.

By A. CLASSEN and O. BAUER.

HYDROGEN peroxide has hitherto met with no application in analytical laboratories as an oxidising agent, a circumstance due to the fact that it has been difficult to procure in a pure and sufficiently concentrated state. A solution containing 3 to 4 per cent is now prepared by Carl Roth and Co., of Berlin, and may be had acidulated either with hydrochloric or with sulphuric acid.

It is already known that hydrogen peroxide oxidises arsenious acid to arsenic, and phosphorous acid to phosphoric; also that hydrogen sulphide is converted into water with liberation of sulphur. The latter reaction does not occur if the hydrogen peroxide is applied in an ammoniacal solution. If ammonium or sodium sulphide is mixed with hydrogen peroxide heat is evolved, and the liquid is decolourised without the slightest separation of free sulphur. The liquid is found to contain a sulphate and a hyposulphite. But if, after adding the hydrogen peroxide, the mixture is heated for some time to a boil, a sulphate alone is produced.

On passing hydrogen sulphide into a solution of hydrogen peroxide placed in an absorption apparatus, and rendered strongly alkaline with ammonia, sodium carbonate, or potassa, the transitory formation of ammonium, &c., sulphide is observed at the point of entrance; but here also complete oxidation to sulphuric acid takes place.

If to solutions of tin, antimony, and arsenic sulphide in ammonium sulphide, hydrogen peroxide is gradually added, the ammonium sulphide is first oxidised, and there appear transient precipitates of the metallic sulphides. If an excess of the reagent is used, and the mixture is heated, the tin sulphide passes completely into insoluble oxide, the antimony partly into insoluble oxide, but partly into a soluble antimony compound, whilst the arsenic entirely becomes a soluble arseniate. If hydrogen peroxide acts upon sodium-tin sulphide, then, according to the quantity of the sodium sulphide present, either the whole or the larger portion of the tin remains in solution.

The behaviour of hydrogen peroxide with ammonium sulphide, or of hydrogen sulphide with ammoniacal hydrogen peroxide, may therefore be used qualitatively for the destruction of these compounds, and quantitatively for determining hydrogen sulphide, whether gaseous or in solution, and for determining the sulphur or the metal in metallic sulphides. In cases where the sulphide can be decomposed by the direct action of hydrogen peroxide in presence of ammonia, it takes place in this manner; in other cases, as in the sulphides which on heating with hydrochloric acid evolve definite quantities of sulphuric acid, it takes place by conversion into sulphuric acid or barium sulphate. Just as hydrogen sulphide or metallic sulphides are oxidised to sulphuric acid or to sulphate, sulphurous acid and sulphites are oxidised to sulphuric acid or sulphates. These reactions may be utilised in various directions.

Several metallic sulphides are completely oxidised by ammoniacal hydrogen peroxide without the formation of precipitates, as the sulphides of arsenic, copper, zinc, and thallium. After the expulsion of the ammonia all the copper is deposited by a copper solution as a dirty green precipitate, not changed by ignition. From the zinc solution only a part of the zinc is separated as a white deposit. On the action of hydrogen peroxide upon antimony trisulphide a part of the antimony separates as a white precipitate, whilst the liquid contains all the sulphur as sulphuric acid. Tin sulphide is decomposed in a similar manner, oxide being deposited and the sulphur oxidised to sulphuric acid. With the other metallic sulphides the behaviour of hydrogen peroxide is very various. It attacks mercury sulphide, which is scarcely affected by nitric acid,

very energetically. After the expulsion of the mercury there remains a spongy precipitate which settles quickly, dissolves in hydrochloric acid, and is converted into a white powder by the action of nitric acid. After the conversion of mercury sulphide by the action of hydrogen peroxide, no mercury can be detected in the filtrate. Cadmium sulphide is decomposed with formation of a yellowish white precipitate, easily soluble in hydrochloric acid. When the oxidation is completed a part of the cadmium remains in the filtrate as sulphate.

Certain metallic sulphides, the solutions of which in acids are precipitable by ammonia, are decomposed by hydrogen peroxide with formation of sulphuric acid and separation of hydroxides; thus iron sulphide, which is oxidised as just mentioned, and manganese sulphide, which is quickly and completely decomposed with formation of sulphuric acid and separation of a mixture of hydrated peroxide and oxide. On heating cobalt sulphide with ammoniacal hydrogen peroxide there is first formed soluble cobalt sulphate, which on prolonged heating is further attacked with formation of a dirty brown precipitate. Nickel sulphide is decomposed in the same manner, with formation of a green precipitate which does not contain all the nickel. Silver and bismuth sulphides are not attacked by ammoniacal hydrogen peroxide; lead sulphide is readily converted into sulphate.

It remains to examine the several precipitates more closely, and ascertain whether the different behaviour of the sulphides with hydrogen peroxide can be used for effecting separations.

The property of hydrogen peroxide in alkaline solution, of easily and completely oxidising hydrogen sulphide to sulphuric acid, may be used, in the first place, for the determination of hydrochloric, hydrobromic, and hydriodic acids in liquids containing hydrogen sulphide. These determinations have occasioned much trouble to analysts.

For the determination of hydrochloric acid along with hydrogen sulphide an ammoniacal solution of hydrogen peroxide is added, and the mixture is boiled until no more bubbles of oxygen rise up. Nitric acid and silver nitrate are then added, and the silver chloride is determined in the usual manner.

For hydriodic acid in presence of hydrogen sulphide the procedure is similar, but the hydrogen peroxide is used mixed not with ammonia, but with sodium carbonate. The mixture is boiled as before, and silver nitrate is added, and nitric acid until a faintly acid reaction is produced.

In estimating hydrobromic acid under similar circumstances the process is exactly the same as for hydriodic acid.

In the metallic sulphides capable of direct oxidation by hydrogen peroxide the quantity of metal can be calculated from the sulphuric acid formed. This method is applicable to the sulphur compounds of arsenic, antimony, zinc, copper, and cobalt. The sulphide is dissolved in ammonia, treated with sufficient hydrogen peroxide, boiled to expel excess, the liquid is acidulated with hydrochloric acid, and the sulphuric acid precipitated with barium chloride.

Antimony trisulphide is treated exactly like arsen trisulphide. Antimony penta-sulphide is incompletely oxidised by hydrogen peroxide.

Sulphides which dissolve by boiling with hydrochloric acid, with liberation of hydrogen sulphide, can be rapidly and accurately determined by converting the latter compound into sulphuric acid. This principle has been used by one of the authors for years in determining the sulphur in ultramarine, in crude iron, &c., the agent for oxidising the sulphur being a solution of bromine in hydrochloric acid.—(Classen, "Quantitative Analysis," 2nd edition, p. 28.)

The unpleasant properties of bromine, and the circumstance that the precipitation of the sulphuric acid must be preceded by the expulsion of the excess of bromine and hydrochloric acid, during which operation sulphur is

often separated, render this method objectionable. Hydrogen peroxide offers the great advantage that the precipitation of the sulphuric acid can take place at once after completion of the manipulations, the liquid containing no substances which can interfere with the separation of pure barium sulphate.

The determination of the metal from the quantity of the hydrogen sulphide evolved is capable of more general application than the determination by the direct oxidation of sulphur to sulphuric acid. In analytical operations there result, as a rule, not pure sulphides, but mixtures containing more or less free sulphur. Thus the determination of tin is almost always preceded by a separation consisting in treating the sulphides with sodium or ammonium sulphide; from these solutions the sulphides are separated again, accompanied by abundance of sulphur. The determination of antimony and tin in these mixtures is no easy task, and in any case it involves the expenditure of much time.

The authors have endeavoured to determine a number of metallic sulphides in the manner indicated, and have obtained very satisfactory results as regards accuracy and speed.

For the determinations they have used the apparatus which one of them has proposed for the estimation of hydrogen sulphide and carbonic acid.—(Classen, "Quant. Analyses," pp. 28 and 239.)

The small flask which serves to receive the metallic sulphide to be decomposed is closed with a stopper having three perforations. Into one passes the delivery-tube, into the second a funnel-tube, and into the third a tube for introducing carbonic acid. The delivery-tube is surrounded with a refrigerator, which serves to condense hydrochloric acid, and is connected with a second perpendicular glass tube filled with glass globules, and in which the hydrogen sulphide is oxidised by hydrogen peroxide constantly trickling down. The liquid which collects can be let off by a glass cock. In order to drive all hydrogen sulphide out of the liquid and the apparatus into the tube filled with glass globules, the entrance tube is connected with a Kipp's carbonic acid apparatus. The substance to be decomposed is placed in the flask, about 50 c.m. dilute hydrochloric acid are allowed to enter through the funnel-tube, and a moderately strong current of carbonic acid is then caused to pass through the liquid. At the same time an ammoniacal solution of hydrogen peroxide (or under certain circumstances a solution mixed with soda, potassa, or sodium carbonate) is caused to fall, drop by drop, into the tube filled with glass-globules escaping below, in such a manner that one-third of the tube remains always filled with the liquid. The contents of the flask are heated to a boil. The whole operation is complete in from fifteen to twenty minutes. After rinsing out the absorption-tube with water the liquid, collected in a covered beaker set below the tube containing the glass-globules, is cautiously acidified with hydrochloric acid, boiled in order to decompose hydrogen peroxide, and precipitated with barium chloride. The authors observe that the precipitate of barium sulphate is more granular than usual, subsides very readily, and is easy to filter. In this manner the antimony sulphides were determined, and gave good results.

Tin sulphide was dissolved in sodium sulphide, precipitated with dilute sulphuric acid, washed, placed along with the filter in the flask of the above-described apparatus, and decomposed with dilute hydrochloric acid.

As arsen sulphide is not decomposed by dilute hydrochloric acid, the authors attempted to use this reaction for the determination of tin and antimony in presence of arsenic. The results were quite unsatisfactory.

The determination of cadmium sulphide was satisfactory, as also that of iron sulphide.

The determination of sulphurous acid in any sulphite is conducted on exactly the same principles as that of hydrogen sulphide in a metallic sulphide. If the sulphite contains no sulphate the conversion into sulphuric acid may be effected by the direct action of an alkaline solution of

hydrogen peroxide. In the other case the sulphurous acid is expelled by boiling with dilute hydrochloric acid, and the sulphur dioxide is oxidised like hydrogen sulphide.

Sodium hyposulphite is decomposed on boiling with hydrochloric acid, sulphur being deposited and sulphur dioxide formed. This method permits of the determination of sodium hyposulphite, sulphite, and sulphate, when occurring together. The weighed substance is decomposed in the apparatus by means of hydrochloric acid, the sulphur dioxide corresponding to the sulphite and hyposulphite is determined, the sulphur remaining in the flask is weighed on a tared filter, and the sulphuric acid in the filtrate is precipitated as barium sulphate. From the quantity of the sulphur that of the hyposulphite is calculated.—*Berichte Deutsche Chem. Gesell.*

ON THE ACTION OF CERTAIN VEGETABLE ACIDS ON LEAD AND TIN.*

By FRANCIS P. HALL.

THE enormous and continually increasing use of canned goods—fruit, vegetables, meat, &c.—has led to the discussion, on sanitary grounds, of the possible injurious effect of the material of the can on its contents; and among other chemical questions is that of the effect of various vegetable acids upon the material of the cans, *i.e.*, upon the can itself and upon the solder which may be exposed on the inside. The fear also has arisen lest the tin-plate itself of which the cans are made should, for the sake of greater cheapness, be made not with pure tin, but with an alloy of lead and tin.

The following paper contains the results of experiments on the action of certain acids on tin and on alloys of tin and lead, and also the results of some investigations as to the quality of the tin-plate and tin-foil in actual use as envelopes for food products.

On the Action of Vegetable Acids on Alloys of Lead and Tin.

One of the most important things to be considered in investigating the power of an alloy to resist corrosion is the electrical relation of the metals which compose it. Lead and tin are so nearly alike in this respect that their relation to each other may be reversed in different liquids, or even in the same liquid under different circumstances. On this subject chemical literature contains many and quite discordant statements. It seems, however, to be fully established by the experiments of Weber† that ordinary vinegar will dissolve lead from an alloy of lead and tin containing only 5 per cent. of lead, and further, that from a dilute acidulated solution of acetate of lead, lead is precipitated by an alloy containing as little as 5 per cent of tin.

In the following investigation I wished to ascertain quantitatively the action of several of the more common vegetable acids, all quantitative experiments that I had seen being made with acetic acid only.

To ascertain definitely the effect of alloying on the corrosion of the metals, the amount of lead or tin dissolved when pure must be compared with the amount dissolved, under the same conditions, from an alloy exposing the same surface of the metals in question. To make the experiment, as is usually done, with equal sized pieces of pure metal and alloy is not fair, if we consider the action to be proportional to the surface of metal exposed, because then the united surface of the two pieces of pure metal is twice that of the alloy and the surface of either metal exposed in the alloy is less than that exposed by the piece of pure metal.


To overcome this difficulty I proposed to proportion the size of the pure metal plates according to the composition of the alloy. In order to proportion them more easily and to have them of a size readily comparable with one another, I took into account the specific gravity of the metals in making the alloys. Hence, barring the unequal contraction of the metals on alloying, I had alloys exposing a known surface of lead and tin. I could now expose an equal surface of pure metal to the same acid under the same conditions and compare the action, thus getting a fair idea of the effect of alloying the metals, as well as the action of the acid on a known surface of pure lead or tin.

I made after this plan three alloys—one with equal parts of lead and tin, one with an excess of lead, and one with an excess of tin. These were all I had time to experiment with, but the researches of Weber* show that, for acetic acid at least, the action on the alloys increases quite regularly as the proportion of lead increases; therefore the action on alloys containing lead and tin in different proportions than those I took can be inferred with fair accuracy by interpolation.

The alloys were made from pure lead and tin, well stirred when melted, then cast in thin sheets in iron moulds. Afterwards these sheets were rolled into thin strips and trimmed to the size desired. Strips of pure lead and tin were made at the same time. The tin used was Banca tin, containing 99.78 per cent. of tin, a trace of lead and a trace of copper.

For acids I used a solution of glacial acetic acid in distilled water, which, on titration with a standard solution of ammonia, proved to have a strength equal to 5.75 per cent. of acetic acid; also solutions of crystallised tartaric and citric acids, which neutralised the same amount of ammonia.

The tartaric and citric acids contained, as they always do, a trace of lead, but the amount was much too small to appreciably influence the results.

Strips of the alloys 1.2 inch wide and 12 inches long were cut out, exposing, therefore, counting both sides, 28.8 square inches or one-fifth of a square foot. Pieces of pure lead and tin were taken of the same width, but varying in length to suit the composition of the alloy to which each corresponded. These strips of metal were rubbed until perfectly bright, washed with a little dilute alcohol, heated in a drying closet, and when cool weighed. Immediately after weighing they were put into separate beakers each containing 200 c.c. of acid. The long strips were coiled and kept off the bottom of the beaker by a  of glass rod. In each case the liquid covered the metal by more than an inch, so that the air did not take part directly in the action. Each beaker was covered with a watch glass.

After standing for two weeks in a place where the temperature varied from 25° to 35° Centigrade, the contents of the several beakers were examined. The most notable change was that the acid containing the tin, as well as that containing the alloys, had a decided yellowish tint, while that containing the lead was perfectly clear and colourless. The metal in all cases was more or less tarnished, but the tin much more noticeably so than the lead. Two of the alloys in the acetic acid were sprinkled with little black crystals. These crystals were evidently metallic; they were carefully collected, washed with alcohol, dried and analysed. The result of the analysis is given later. The smallest of the pieces of lead in the tartaric acid was covered with small transparent crystals; these were set aside for further examination. The pieces of tin were covered with a dusty powder, but there was not enough of it to analyse.

When the contents of each beaker had been carefully examined, the strips of metal were lifted out, washed with a jet of water, dried with a soft towel, and, after remaining a while in a drying closet, weighed. The loss of weight served as a rough check on the subsequent

* *American Chemical Journal*, vol. iv., No. 6.

† *Dingl. Polyt. Journ.*, 232, pp. 153, 264; *Wagner, Jahresb.*, 1879, 196-207.

* *Loc. cit.*

TABLE I.

Kind of Acid.	Surface exposed, in sq. inches.		Percentage composition.		Loss of weight, in grms.	Found in solution, in grms.		Percentage of dissolved metals.		Total amount dissolved (in grms.) from	
	Lead.	Tin.	Lead.	Tin.		Lead.	Tin.	Lead.	Tin.	Alloys.	Pure Metals.
Acetic ..	7.2	—	100.0	—	0.4320	0.4216	—	—	—	—	—
" ..	7.2	21.6	34.1	65.9	0.4525	0.0432	0.3312	11.54	88.46	0.3744	0.7122
" ..	—	21.6	—	100.0	—	—	0.2906	—	—	—	—
" ..	14.4	—	100.0	—	0.5470	0.5444	—	—	—	—	—
" ..	14.4	14.4	60.8	39.2	0.5145	0.0558	0.3552	13.57	86.42	0.4110	0.8242
" ..	—	14.4	—	100.0	0.2820	—	0.2798	—	—	—	—
" ..	21.6	—	100.0	—	0.6195	0.6137	—	—	—	—	—
" ..	21.6	7.2	80.84	19.16	0.6570	0.4887	0.1589	75.46	24.54	0.6476	0.8073
" ..	—	7.2	—	100.0	0.2135	—	0.1936	—	—	—	—
Tartaric ..	7.2	—	100.0	—	—	0.0452	—	—	—	—	—
" ..	7.2	21.6	34.1	65.9	0.0280	0.0029	0.0269	9.73	90.27	0.0298	0.0664
" ..	—	21.6	—	100.0	0.0210	—	0.0212	—	—	—	—
" ..	14.4	—	100.0	—	0.6605	0.0586	—	—	—	—	—
" ..	14.4	14.4	60.8	39.2	0.0385	0.0042	0.0332	11.23	88.77	0.0374	0.0750
" ..	—	14.4	—	100.0	0.0150	—	0.0164	—	—	—	—
" ..	21.6	—	100.0	—	0.0655	0.0654	—	—	—	—	—
" ..	21.6	7.2	80.84	19.16	0.0345	0.0080	0.0269	22.92	77.08	0.0349	0.0787
" ..	—	7.2	—	100.0	0.0115	—	0.0113	—	—	—	—
Citric ..	7.2	—	100.0	—	0.3540	0.3521	—	—	—	—	—
" ..	7.2	21.6	34.1	65.9	0.1690	0.0165	0.1461	10.15	89.85	0.1626	0.4785
" ..	—	21.6	—	100.0	0.1175	—	0.1264	—	—	—	—
" ..	14.4	—	100.0	—	0.4355	0.4348	—	—	—	—	—
" ..	14.4	14.4	60.8	39.2	0.1725	0.0210	0.1355	13.42	86.58	0.1565	0.5439
" ..	—	14.4	—	100.0	0.1080	—	0.1111	—	—	—	—
" ..	21.6	—	100.0	—	0.4870	0.4875	—	—	—	—	—
" ..	21.6	7.2	80.84	19.16	0.2305	0.0982	0.1221	44.58	55.42	0.2203	0.5946
" ..	—	7.2	—	100.0	0.1030	—	0.1071	—	—	—	—

analysis of the solutions. Next, the metal in solution was precipitated by sulphuretted hydrogen. The lead caused dense black precipitates, much finer in the tartaric and citric acid than in the acetic. The tin in the acetic acid came down of a dark brown colour, showing the stannous salt, while that in the tartaric acid gave, at first, merely a yellow colouration. After standing some time, however, a flocculent, apparently hydrated precipitate settled out. The same seemed to be the case with the citric acid solutions, but on closer examination an almost transparent precipitate could be seen, and it settled much quicker than in the case of the tartaric acid. These same peculiarities of the precipitates of sulphide of tin were noticed throughout the whole investigation. It was also invariably the case with the alloys that the precipitates in acetic acid were dark brown, while those in tartaric and citric acids were light coloured and flocculent.

After some experimenting I found the best way to separate the sulphides of lead and tin in the solutions was to carefully decant as much as possible of the liquid through a filter, neutralise what remained with ammonia water, add a little yellow ammonium sulphide, and heat; then collect the sulphide of lead on the filter used before. The tin was determined in the alkaline filtrate. The sulphide of lead was converted into the sulphate before weighing; the sulphide of tin into the oxide in the usual manner. In no case was either metal determined by difference.

The results obtained are given in the form of tables. The first two columns of Table I give the amount of surface of each metal exposed both as pure metal and in the alloy. The last two give the total weight of metal, lead and tin, dissolved from the alloy, and from an equal surface of the same metals exposed in the pure state. But although the surface exposed was the same, the unalloyed metals were exposed to twice as much acid, each being in a separate beaker with 200 c.c. of the acid. This might have been righted by proportioning the acid to the surface exposed, but this did not occur to me until too late. It will be noticed how often the amount dissolved

when unalloyed is equal to twice that dissolved from the alloy.

The alloys Nos. 1 and 2 in the acetic acid were the ones on which the small black crystals before mentioned were found. The crystals on No. 1 weighed 0.0970 gramme, and gave on analysis 0.0931 gramme of lead, or 91.6 per cent. Those on No. 2 weighed 0.0620 gm., and gave 0.0586 gm. of lead, or 94.45 per cent. They were evidently, therefore, crystals of lead. This amount of lead might have been considered as having been in solution, but it is not included in the amount given in the tables. Weber* noticed similar crystals in his experiments, and explained their presence by supposing that, at the surface of the liquid where the oxygen of the air and the acid both acted on the metal, so much lead was dissolved that it was precipitated again by the tin of the alloy below the surface. As, in my experiments, the metal was kept entirely covered by the acid, this could hardly have been the case.

The transparent crystals found on the smallest piece of lead in the tartaric acid were nearly, if not quite, insoluble in water. Under the microscope they appeared to be hexagonal and very much like small quartz crystals. They were found, on comparison, to have the same form as crystals of tartrate of lead. From this and from a few qualitative tests I decided that they must be tartrate of lead. The crystals adhered so firmly to the lead that they could not be removed,—therefore the loss of weight, as well as the lead in them, could not be determined.

The results of the experiment agree in all essential points with those statements which I have found that have been supported by actual experiment. Those statements which would have us suppose that alloying with tin increased the corrosion of lead seem to be founded on the case of some stray tank or pipe, rather than on a well-conducted research. Moreover it does not appear, as is often supposed to be the case, that the alloy is more acted upon than either of the metals.

(To be continued.)

* *Loc. cit.*

NOTICES OF BOOKS.

Annual Report of the Chief Engineer of the Water Department to the City of Wilmington, Delaware, for the Year 1882. Also a Report of the Water Supply of Wilmington, including Sanitary Analyses of the Brandywine River, from Coatesville to Wilmington, and of Mill, White Clay, and Red Clay Creeks. By Prof. A. R. LEEDS, Ph.D. Together with the Report of Prof. Ira Remsen on Samples of Water furnished him from Cool Spring Reservoir, White Clay and Red Clay Creeks. Wilmington, Delaware: James and Webb.

THE growing density of population and the spread of manufactures in the United States render the domestic water-supply a difficult question. It is worthy of notice that the various municipalities, as is done in the North of England, find it prudent to keep this matter in their own hands. From the Report before us, we glean some very interesting facts. Thus the daily water-supply at Wilmington is 106 gallons daily per head,—a very large excess. The engineer recommends the introduction of water-meters, as calculated to reduce the present charges. He points out that on the existing system those who do not use or waste the water are very unfairly compelled to pay for those who do. Of all methods of charging for water that adopted in some parts of England of making it dependent upon the value of the premises is the least equitable, involving as it does the corollary that an increase in the value of a house raises the cost of water.

As far as we can judge, the supply at Wilmington is constant. The annual charge for dwelling-houses is 5 dollars for a hydrant, 3 for a bath, 2 for a W.C., wash-basins (we presume fixed, with outflow pipe) 1 dollar, hose for washing pavements 2 dollars, and water-motors for sewing machines 3 dollars.

Professor Leeds, in his Report on the quality of the water in the Brandywine River, had all his sixteen samples from different places collected on the same day. He does not find that the waters undergo any important change in the time which elapses between their collection and the actual performance of the analysis.

The determinations made have included free and albumenoid ammonia, oxygen required to oxidise organic matter, nitrites, nitrates, chlorine, hardness, total solids, mineral matter, and hardness and volatile matter. In the determination of the free and albumenoid ammonia, Prof. Leeds has followed the method of Wanklyn and Chapman, but with certain modifications. These are the employment of a colorimeter—here figured—for effecting the comparison of the test with the standard under constant conditions, and the substitution of a standard wedge, graduated with extreme care and nicety, for the various standard solutions which have to be freshly prepared for each analysis.

The determination of the oxygen required to oxidise organic matter has been effected on Kübel's method,—the use of potassium permanganate at a boiling heat. It is remarked that the figures thus obtained are higher than when a partial oxidation is effected at common temperatures, even on prolonged standing.

In determining nitrites the author makes use of Griess's reaction,—the brown colouration observed when meta-diamido-benzol is brought in contact with nitrites, available for one part of nitrous acid in ten million parts of water, and the still more delicate test proposed by the same chemist, the pink colour produced when naphthylamine hydrochlorate and sulphanilic acid react upon nitrous acid. This test enables us to recognise one part of nitrous acid in 1000 million parts of water. Nitric acid was determined by Kübel's method,—the decolouration of indigo by the nitric acid in a strongly acidified solution. Professor Leeds lays considerable weight upon the determination of the nitrites and nitrates as giving a measure of "previous sewage contamination." But he attaches little import-

ance to the determinations made by evaporating to dryness and subsequent ignition. He shows that the figures obtained by these operations can never represent either the total solids, the organic and volatile matter, or the mineral matter.

The remarks of Professor Leeds on the interpretation of the data obtained in water analysis may be characterised as eminently judicious, and demand the serious consideration of sanitary authorities. He admits that the chemist cannot isolate and exhibit the disease germs,—the actually dangerous ingredients. But he argues that when water contains nitrogenous organic matter, especially of a very unstable character and prone to decomposition, in abnormal amount, there is at least a reasonable presumption that those living organisms which produce specific disease may be present also. His reasoning is here analogous to that which connects an excess of carbonic acid in the atmosphere with danger to health. The carbonic acid is not dangerous *per se* in the proportions in which it ever occurs in the air, but any excess above 4 parts in 10,000 is usually accompanied by questionable exhalations from living or decaying organisms. He maintains, as a chemist of very wide experience, that whenever he has analysed a water obviously free from contamination he has found the albumenoid and free ammonia and the nitrites either very low or entirely absent. On the other hand, waters from contaminated sources as regularly show an excess of ammonia, nitrates, and nitrites. Hence he concludes that chemical analysis can give a definite answer to the inquiry as to the wholesomeness or unwholesomeness of a specimen of water.

We have spoken in expounding the author's views of an abnormal amount of nitrogenous organic matter, and we find him further speaking of standards of purity. But his standards are founded on long-continued observation and analysis of some particular river, or of a particular class of wells in a certain restricted locality. He writes,—and in our opinion with great truth,—“It will not answer to apply to wells situate at Ocean Grove the same standards as to those in New York city, nor to either the same standards as those which are applicable to a river contaminated by sewage and factory refuse, like the Passaic or the Brandywine. The water analyst, by constant comparison of his analyses with the sanitary properties of the waters analysed, becomes able to set up a standard from which the water does not depart without becoming more and more objectionable.” As a maximum limit, Professor Leeds proposes, per 100,000 parts, free ammonia, 0.001 to 0.012; albumenoid ammonia, 0.01 to 0.028; nitrites, 0.0001 to 0.001; nitrates, determined by Kübel's method, 0.5 to 1.75; chlorine, 0.3 to 1.00; and oxygen required, according to Kübel's method, 0.5 to 0.7.

As regards chlorine, the maximum limit here proposed agrees with that recommended by the late Royal Rivers' Pollution Commission. For organic nitrogen, Prof. Leeds is more stringent than the Commission, which fixes no standard for free ammonia, nitrites, nitrates, or oxygen required.

The author's observations and experiments lead him to conclude that “there is no foundation in fact for the oft-repeated statement that water once polluted by sewage can never again become safe for drinking purposes.” He points to the various natural purifying agencies constantly at work, giving especial prominence to the action of aquatic plants and to that of the finely-divided earth washed into rivers by the rains, the former influence oxidising and the latter occluding and precipitating organic impurities. As an instance of the efficacy of these natural agencies, he refers to the River Passaic,—pure above the town of Paterson, but polluted by the sewage and the manufacturing refuse of that town. “The river immediately below the town is black with dye-wares, the fish carried over the great falls are immediately poisoned, and I have often seen the foul-smelling and disgusting water covered with their floating carcasses.” Yet samples taken at intervals of a mile apart down the

river show a regular diminution in the albumenoid ammonia, a disappearance of the nitrites, and as regular an improvement in the quality, until at a point sixteen miles below Paterson the river has returned to a condition of purity not far below that it exhibited above Paterson, and at this point it is used as a water supply of the three hundred thousand inhabitants of Jersey City and Newark. These observations agree closely with those on the Vesle, at Rheims. We are bound, however, to admit that they harmonise less with the phenomena to be recognised in the course of the Irwell and Mersey, or of the Calder and Aire. Part of the discrepancy may be traced to the relative volumes of the rivers and of the sewage, part to the difficulty of finding in the English manufacturing districts a run of sixteen or twenty miles without fresh sources of contamination, and partly to the longer continuance, with us, of the pollution. In some of our streams the deposit of earth, &c., containing putrescible organic matter has accumulated to a depth of two feet or more. On a fall of the barometer, cakes of this matter, buoyed up by the gases evolving, rise to the surface, and restore a part, at least, of the offensive substances to a state of solution.

There is a further question: We have seen and we know that organic impurities in rivers are consumed by, e.g., the oxygen given off by aquatic vegetation. But does this process of destruction go on *pari passu* with living organism as with lifeless organic matter? Unless this question can be answered in the affirmative, a river once polluted may not be sufficiently purified to be safe for drinking and culinary uses. Here careful observation must be our guide.

This pamphlet, especially the report of Professor Leeds, must take rank as a valuable contribution to sanitary literature.

Report and Proceedings of the Manchester Scientific Students' Association for the Year 1882. Published by the Society, 1883.

THE Manchester Students' Association has been in active existence for twenty-one years, and seems to have done good service in bringing scientific students into mutual contact, and thus stimulating their zeal for research and enlarging their ideas. We find, however, one of the oldest members of the Association, observing with regret that, while there is a large attendance at the field meetings, the number of real students taking part in them had become more limited. "In the early days the members had a student's enthusiasm, and it was rare to see anyone at the excursions who was not diligently prosecuting some branch of natural science, whereas to-day the worker is the exception."

The total number of members of the Association is now 396. Among the papers read we may mention: "Use of Gas as a Workshop Tool," "Progress of Invention," "Secondary Batteries," "Asbestos," "Natural Crystals," "Meteorites," and "Arts and Manufactures of the Ancients."

CORRESPONDENCE.

ESTIMATION OF CHROMIUM.

To the Editor of the Chemical News.

SIR,—On referring to the CHEMICAL NEWS for Feb. 16, 1877 (vol. xxxv., p. 67), Sergius Kern, of St. Petersburg, in his estimation of chromium states that "the resulting chromium oxide (Cr_2O_3) is weighed, and the percentage is calculated, knowing that this compound contains 32.2 per cent of chromium."

I find that Cr_2O_3 contains 68.63 per cent chromium and 31.37 per cent oxygen, and should be glad if he would kindly state how he obtains the above figures.—I am, &c.,
INTERESTED.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 22, May 28, 1883.

General Considerations on Scientific Methods and Applications of the *a posteriori* Method of Newton and the *a priori* Method of Leibnitz.—E. Chevreul.—A long and discursive treatise, which does not admit of useful abstraction.

Remarks on Violet Iridium Sulphate.—Lecoq de Boisbaudran.—The author, in his last communication, has not clearly described the behaviour of green iridium sulphate with potassa in the cold. He stated that the colour changes to a pale blue, but without immediate precipitation. He should have said that the colour changes to a light blue without the immediate precipitation of the violet-blue oxide; for the initial light blue tint is due to the opalescence produced by a bulky greenish blue precipitate, which shrinks up into a green or greenish powder, which turns slowly to a violet-blue generally after having passed through a violet shade. These violet and violet-blue colourations show themselves more rapidly in heat, and appear doubtless due to an oxidation. Thus a boiling solution of green iridium sulphate, if supersaturated with boiling potassa, takes at first merely a very light violet shade. If agitated in presence of air the violet tint deepens, turning more to a blue, and the dark violet-blue oxide is deposited. In an atmosphere of hydrogen, neither a violet nor a blue colour appears, even in heat, but the reaction takes place as soon as air is introduced into the alkaline liquid. The re-introduction of the current of hydrogen causes the violet or the blue tint to disappear anew, the precipitate retaining merely a grey shade. Sulphurous acid at first turns the violet iridium sulphate blue, and then decolourises it entirely. When the violet blue oxide has been dried, or even submitted to prolonged ebullition, it is only partially soluble in dilute sulphuric acid. The aqueous solution of the pansy-violet sulphate loses almost entirely its colouration if boiled for a long time; if it is then supersaturated with potassa it becomes coloured again, and gives an abundant violet-blue precipitate, soluble in dilute sulphuric acid with a colour decidedly more blue than that of the original pansy-violet sulphate. The same transformations take place in the cold, but more slowly. The colour of the violet sulphate turns to a bluish, becoming fainter at the same time. Hydrochloric acid dissolves the violet-blue oxide, yielding a pansy-violet solution, which passes successively to a blue, a green, and finally to an orange-yellow. Heat greatly accelerates the reaction. The author adds that the rose reaction (C), mentioned in his last communication but one (*Comptes Rendus*, 1883, p. 1339), appears still more sensitive than the blue reaction (B). It is certain that if B has failed in consequence of the two free addition of ammonium nitrate, it is sufficient to throw a little ammonium chloride upon the hot assay, when a very distinct rose colouration is developed.

Transfer of Mechanical Energy.—Marcel Deprez.—The author shows that the intensity of the current depends only on two variables: the economic yield which it is wished to obtain, and the ratio of the mechanical work of the recipient to the total resistance of the circuit.

Connexion between Eclipses and Terrestrial Magnetism.—P. Denza.—The conjunction of two heavenly bodies in eclipses of the sun, and their opposition in eclipses of the moon, have no influence upon the magnetic elements of the earth.

Hydrates of Baryta.—M. Lescœur.—Barium oxide forms three hydrates with, respectively, 1, 2, and 9 mols.

of water. The second of these compounds loses half its water at the temperature of 100° in a vacuum, and is converted into the mono-hydrate.

Composition of the Mineral Water of Montrond (Loire).—A. Terreil.—The water in question is charged with sodium bicarbonate, and is strongly ferruginous, besides containing small quantities of arsenic and phosphoric acids and iodine.

Certain Compounds belonging to the Group of Creatines and Creatinines.—E. Duvillier.—The author has studied the action of cyanamide upon methyl-amido- α -caproic acid and the corresponding ethyl compound.

Panary Fermentation.—G. Chicandard.—The fermentation of bread does not consist in a hydration of the starch, followed by alcoholic fermentation. It is not determined by a *Saccharomyces*. It consists in a transformation of a portion of the insoluble albumenoids of the gluten, first, into soluble albumens, and finally into peptones. The starch is only modified by baking, which forms soluble starch in great quantity, and a little dextrine, the latter especially in those portions which have been most strongly heated. The agent in panary fermentation is a bacterium which is developed normally in the paste, and beer-yeast merely accelerates this development.

A Saccharine Substance obtained from the Lungs and the Sputa of Phthisical Patients.—A. G. Pouchet.—The aqueous solution of this salt is altered with great rapidity on exposure to the air, whilst lactic and butyric acids appear in the liquid. The solution does not immediately reduce or hydrate Fehling's liquid. On prolonged boiling there is a slight reduction of copper in consequence of the new body being converted into glucose by hydration and oxidation.

On Condiments, and in Particular on Salt and Vinegar, from an Alimentary Point of View.—C. Husson.—Salt, in slight proportions, facilitates digestion, but if it exceeds from 5 to 10 grms. per half kilo. of food it acts injuriously by rendering the muscular fibre more resistant to the gastric juice and by retarding the gastric fermentation. Similar conclusions apply to the organic acids. Incidentally the author remarks that it is not easy to reckon on the effects of the pepsines of commerce.

Justus Liebig's Annalen der Chemie,
Band 218, Part 2.

Action of Aldehyds upon Ketons, Malonic Acid, and Acetacetic Ether.—L. Claisen.—The author has examined the action of benzaldehyd upon certain ketons and ketonic acids in presence of hydrochloric acid, and found that acetone combines with benzaldehyd, forming, according to circumstances, mono- or dibenzal-acetone. In the same manner he obtains from acetophenon, benzal-acetophenon, and from pyruvic acid, benzal-pyruvic acid.

Action of Fatty Aldehyds upon Malonic Acid and Ethyl-malonate.—T. Komnenos.—The author investigates the condensation of acetaldehyd and malonic acid, ethyliden-acetic acid and ethyliden-diacetic acid. He then examines the action of acetaldehyd upon malonic ether, ethyliden-malonic ether, and ethyliden-dimalonic ether. He saponifies ethyliden-malonic ether with baryta water and with aqueous alcoholic potassa. He also studies the behaviour of propyl-aldehyd with malonic acid, and the formation and properties of propyliden-acetic and diacetic acids.

Condensations of Acet-acetic Ether with the Aldehyds.—L. Claisen and F. E. Matthews.—An examination of acet-ethyliden-acetic ether, acet-isobutyliden-acetic ether, acet-isamyliden-acet ether, acet-trichlor-ethyliden-acetic ether, acet-furfural-acetic ether, acet-benzal-acetic ether, the hydrochloric compounds of acet-benzal-acetic ether, the action of benzaldehyd upon mono- and diethyl-acet-acetic ether, benzal-acet-ethyl-acetic ether, the corre-

sponding diethyl compound, and the dibromide of this ether.

Action of Benzaldehyd upon Malonic Acid and Malonic Ether.—L. Claisen and L. C ismer.—The authors have obtained and examined benzal-malonic ether, benzal-malonic acid, and have further studied its behaviour with water, its reduction, its behaviour with bromine, and the saponification of benzal-malonic ether with alcoholic potassa.

On Meta-amido-benzamid.—Hugo Schiff.—The mixed nitro-benzoic acids are separated as barium salts according to Griess's method, and the meta-acid is treated with an equivalent quantity of phosphorus chloride. After the product has been gradually heated to 140° in order to remove the greater part of the phosphorus oxychloride, it is poured in a thin stream and with stirring into strong, well-cooled ammonia, and after some hours the crystalline nitro-benzamid is filtered off, washed with water, recrystallised, and converted into amido-benzamid by treatment with colourless ammonium sulphide. If pure benzoic acid has been employed the yield is almost theoretical.

Communications from the Chemical Laboratory of the University of Jena.—These consist of a memoir on benzo-quinone by Dr. B. Scheid, and a paper on saponine by Dr. E. Stütz.

Bulletin de la Société Chimique de Paris.
No. 11, June 5, 1883.

On Prout's Hypothesis.—Max Gerber.—This memoir will be inserted at length.

Study on the Combustion of Explosive Gaseous Mixtures: Speed of Propagation of Combustion.—MM. Mallard and Le Chatelier.—Concluded from pages 2, 98, 268, and 369 of the present volume.

New Class of Boro-tungstates.—D. Klein.—The author obtains a barium boro-decitungstate by treating a boiling concentrated solution of sodium para-tungstate with three-quarters of its weight of boric acid, and adding to the dense mother-liquor an excess of pure barium chloride in a hot saturated solution.

Researches on the Action of Zinc-ethyl upon the Amines and Phosphines: New Method for Characterising the Nature of these Bodies.—H. Gal.—On causing zinc-ethyl to react upon an ammoniacal derivative in which all the hydrogen is not replaced we obtain a metallic derivative, whilst ethyl hydride is disengaged. These reactions are in general very energetic, and it is well to moderate them by using the zinc-ethyl in an ethereal solution. Zinc-ethyl is without action upon the tertiary amines and phosphines. Hence we have a new and easy method for determining to what class an amine belongs. It is merely necessary to place in test-tubes a small quantity of different bases, pouring upon each an ethereal solution of zinc-ethyl. In the tubes containing a tertiary amine we perceive no reaction, whilst in the others there is a regular and abundant disengagement of a combustible gas, ethyl hydride. Reciprocally, if an amine or a phosphine thus treated gives off ethyl hydride it should be considered as containing ethyl hydride. As regards the natural bases, zinc-ethyl is without action upon nicotine and quinoline, but it attacks the greater number of the oxygenated natural bases, forming organo-metallic compounds, which require further study.

Cosmos Les Mondes.
Tome v., No. 3, May 19, 1883.

Combination-Heats of the Soluble Compounds of Copper.—Dr. D. Tommasi.—A table of combination-heats as calculated and as found experimentally.

No. 4, May 26, 1883.

This issue does not contain any chemical matter which has not appeared elsewhere.

No. 5, June 2, 1883.

New Lighting Appliance.—M. de Khotinsky.—The author directs a jet of coal-gas and of oxygen upon a prismatic pencil of magnesia prepared in an especial manner. The gas and the oxygen arrive by two separate pipes inclosed in the same tube.

Reflections on a Point of Thermo-chemistry.—Marcellin Langlois.—The author insists on the necessity of establishing in all possible cases the efficacy of the fundamental principle of thermo-chemistry, *i.e.*, that in order to decompose any substance we must expend the same quantity of energy which was liberated at its formation in the shape of heat. He requests thermo-chemists to determine the quantity of heat liberated in the reaction of chlorine upon yellow mercury oxide.

No. 6, June 9, 1883.

Combination-heats of the Soluble Compounds of Cobalt.—Dr. D. Tommasi.—A comparative table of the heats as calculated and as experimentally determined.

The Magnet and the Magnetic Needle.—Claudio Giordano.—The author maintains that Gilbert was anticipated in his researches on magnetism, not merely by Fra Paolo Sarpi, but by J. B. Porta, Cardan, Mairolico, and others.

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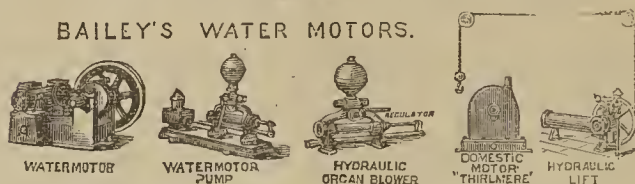
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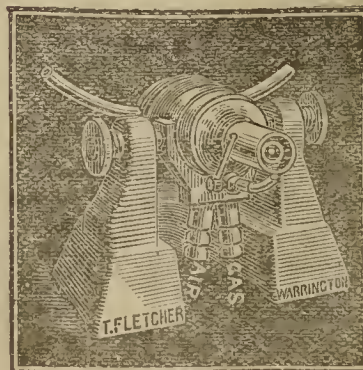
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THE CHEMICAL NEWS.

VOL. XLVII. No. 1231.

REPLY TO A NOTE BY PROFESSOR J. E. REYNOLDS ON THE ATOMIC WEIGHT OF GLUCINUM OR BERYLLIUM.*

By T. S. HUMPIDGE, Ph.D., B.Sc.

IN the above-mentioned note of Professor Reynolds† the author criticises the results detailed in a paper‡ which I recently had the honour to contribute to the Society, and draws an inference from the specific heats of different specimens of the metal which I shall show to be incorrect.

Professor Reynolds remarks that all the results obtained by Nilson and myself tend in one direction, viz., to an increased specific heat as the impurities in the metal diminish. This, however, is clearly not the case, as the following comparison shows. Taking the three samples of which the specific heat has been determined in their order of purity, we have:—

	Percentage of Glucinum.	Specific Heat at 45° to 50°.
Nilson	87.09	0.4084
Humpidge.. .. .	93.97	0.4453
Nilson	94.41	0.4246

In other words, Nilson's picked sample of 2 decigrms., which was purer than mine by 0.5 per cent, has a specific heat about 5 per cent lower. On the other hand, as I have already stated, my result is probably slightly too high, owing to the heat produced on the absorption of the turpentine by the porous metal. In Nilson's experiments the metal was enclosed in a platinum capsule.

The results cannot, therefore, be explained away in this manner, nor does it seem possible that the specific heat of the *fused* metal could be as much as 50 per cent greater than in the crystalline state. It rather appears that glucinum is either an exception to Dulong and Petit's law of atomic heats or to Mendeleef's periodic law. I hope shortly to contribute some further evidence to the solution of this exceedingly interesting question, and am now making preparations for a revision of the specific heats of the solid elements in the pure state, and at different temperatures.

Next with regard to the purity of the metal as prepared by my process. The 7 decigrms. which were used for the determination of the specific heat was the first sample prepared, and included all I had then extracted. It ought not, therefore, to be compared with Nilson's picked 2 decigrms., but rather with his first sample, containing 13 per cent of impurities. Since sending in my paper I have prepared more than 3 grms. of much purer metal, and can now obtain any quantity in yields of 3 to 5 decigrms. for each experiment. The metal is decidedly crystalline in structure, mostly in thin plates of a high metallic lustre, and of a greyish colour resembling iron. No accurate analysis of these samples of the metal has been made, as it has been nearly all used for the attempted preparation of organo-glucinum compounds. But in my next contribution to the Society I hope to be able to give accurate analyses of several samples.

I only briefly alluded to the theoretical aspects of the question in my paper, and do not intend to refer to this until I have more evidence to offer than a determination of the specific heat between 10° and 100° C.; but the very

remarkable result arrived at by Professor Hartley from spectroscopic evidence cannot be left unnoticed. This chemist concludes from his experiments that glucinum is a dyad metal, and that its homologues are calcium, strontium, and barium—elements with which it has not the slightest analogy. And it seems strange that Prof. Hartley should consider some slight spectroscopic resemblance between glucinum and the metals of the alkaline earths to outbalance all the weighty chemical and physical differences between them. Glucinum differs strikingly from the metals of the alkaline earths, both in the free state and combined as oxide, as hydrate, carbonate, oxalate, chloride, fluoride, sulphate, &c. If glucinum is really a dyad metal (which may possibly be the case), its nearest homologues are decidedly magnesium and zinc; not calcium, strontium, and barium.

SUPPLEMENT TO FORMER PAPER ENTITLED "EXPERIMENTAL INQUIRY INTO THE COMPOSITION OF SOME OF THE ANIMALS FED AND SLAUGHTERED AS HUMAN FOOD:" COMPOSITION OF THE ASH OF THE ENTIRE ANIMALS, AND OF CERTAIN SEPARATED PARTS.*

By SIR JOHN BENNET LAWES, Bart., LL.D., F.R.S., F.C.S.,
and JOSEPH HENRY GILBERT, Ph.D., LL.D., F.R.S., V.P.C.S.

IN a former paper (*Phil. Trans.*, Part II., 1859) the authors had given the actual weights and the percentage proportion in the entire body, of the individual organs, and of certain more arbitrarily separated parts of 326 animals—oxen, sheep, and pigs—in different conditions as to age, maturity, fatness, &c. They called particular attention to the wide difference in the proportion by weight of the stomachs and intestines in the three descriptions of animal; the proportion of stomach and contents being very much the highest in oxen, considerably less in sheep, and little more than one-tenth as much in pigs as in oxen. On the other hand, the intestines and contents contributed a less proportion to the weight of the body in oxen than in either sheep or pigs, the percentage by weight in pigs being nearly twice as high as in sheep, and more than twice as high as in oxen. With these very characteristic differences in the proportion of the receptacles and first laboratories of the food, the other internal organs collectively, as also the blood, contributed a pretty equal proportion by weight of the entire body, in the three descriptions of animal.

Ten animals had been selected for the determination of the chemical composition, namely—a fat calf, a half-fat ox, and a fat ox; a fat lamb, a store sheep, a half-fat sheet, a fat sheep, and a very fat sheep; a store pig, and a fat pig. In these in the collective carcass parts, in the collective offal parts, and in the entire bodies, the total nitrogenous substance, the total fat, the total mineral matter, the total dry substance, and the water, were determined; and the results were recorded and discussed in detail.

It was shown that as the animal fattened the percentage of nitrogenous substance decreased considerably, whilst that of the fat and of the total dry matter increased in a much greater degree. It was estimated that the portions of well fattened animals which would be consumed as human food would contain between three and four times as much fat as dry nitrogenous substance; and comparing such animal food with wheat-flour bread, it was concluded that taking into consideration the much higher capacity for oxidation of a given weight of fat than of starch, such animal food contributed a much higher proportion of non-nitrogenous substance, reckoned as starch, to one of

* A Paper read before the Royal Society, June 21, 1883.

† Read May 24, 1883; see CHEMICAL NEWS, vol. xlvii., p. 251.

‡ Read April 12, 1883; see CHEMICAL NEWS, vol. xlvii., p. 181.

* Abstract of a Paper read before the Royal Society, June 21, 1883.

nitrogenous substance than bread. In fact, the introduction of our staple animal foods, to supplement our otherwise mainly farinaceous diet, did not increase, but reduce, the relation of the flesh-forming material to the respiratory and fat-forming capacity of the food.

Finally, the actual amount, and the percentage of total ash, in most of the internal organs, and some other separated parts, were given. It was shown that the percentage of total mineral matter, like that of the nitrogenous substance, decreased, not only in the entire body, but especially in the collective carcass parts, as the animals matured. It was the object of the present communication to record the results of the complete analysis of the ashes of the collective carcass parts, of the collective offal parts, and of all parts of each of the ten animals. Forty complete ash analyses have been made.

As was to be expected, more than four-fifths of the ashes consisted of phosphoric acid, lime, and magnesia; these making up the largest amount in the ash of the oxen, less in that of sheep, and less still in that of pigs. Potash and soda were also prominent constituents. Assuming, for the purposes of the illustration, that one of phosphoric acid was combined with three of fixed base, the ashes of the ruminants showed an excess of base; whereas, according to the same mode of calculation, the ashes of the pigs showed no such excess.

It was, unfortunately, only in the case of the pigs that the ash of the chiefly bony, and that of the chiefly soft offal parts, had been analysed separately. The results showed a considerable excess of acid, especially phosphoric, in the ash of the non-bony portions, presumably, in part at any rate, due to the oxidation of phosphorus in the incineration.

Comparing the percentage composition of the ashes of the entire bodies of the different animals, the chief points of distinction are that, in the ash of the pig there is a lower percentage of lime, and a higher percentage of potash and soda, than in the corresponding ash of the ruminants; a somewhat higher percentage of phosphoric acid in the ash of the pigs and of the oxen than in that of the sheep; and a higher percentage of sulphuric acid (and somewhat of chlorine also) in the ash of the pigs than in that of the other animals.

A table showing the quantities of total ash, and of each individual mineral constituent, in each of the ten animals analysed was given. Not much stress was laid on the amounts in the particular animals, as the actual weights and conditions of animals coming under similar designations may vary considerably.

It was of more interest to consider the amounts of the mineral constituents in carcass parts, in offal parts, and in all parts, of 1000 lbs. fasted live-weight of each description of animal.

It was shown that a given live-weight of oxen carried off much more mineral matter than the same weight of sheep, and a given weight of sheep much more than the same weight of pigs. With each description of animal the amounts of phosphoric acid, lime, and magnesia are less in a given live-weight of the fatter than of the comparable leaner individuals. Of both potash and soda, again, the quantity is less in a given live-weight of the fatter animals. The same may be said of the sulphuric acid and the chlorine; in fact, in a greater or less degree of every one of the mineral constituents.

It was estimated that the loss to the farm of mineral constituents by the production and sale of mere fattening increase was very small. It was greater of course in the case of growing than of only fattening animals. In illustration, the amount of some of the most important mineral constituents removed annually from an acre of fair average pasture and arable land in various products may be compared. Such estimates can obviously be only approximate, and the quantities will vary considerably. With this reservation, it may be stated that, of phosphoric acid, an acre would lose more in milk, and four or five times as much in wheat or barley grain, or in hay, as in the fatten-

ing increase of oxen or sheep. Of lime, the land would lose about twice as much in the animal increase as in milk, or in wheat or barley grain, but perhaps not more than one-tenth as much as in hay. Of potash, again, an acre would yield only a fraction of a pound in animal increase, six or eight times as much in milk, twenty or thirty times as much in wheat or barley grain, and more than 100 times as much in hay.

From the point of view of the physiologist, it would doubtless have been desirable that the selection of parts for the preparation and analysis of the ash should have been different and more detailed. The agricultural aspects of the subject had, however, necessarily influenced the course of the inquiry, and the extent of the essential work had enforced the limitation which had been adopted. The results must be accepted as a substantial contribution to the chemical statistics of the feeding of the animals of the farm for human food.

ON A NEW REACTION OF THE TELLURIUM COMPOUNDS.

By E. DIVERS and M. SHIMOSE.

SULPHURIC acid dissolves tellurium dioxide or its sulphate only in small quantities, but this solution can be utilised for an exceedingly sensitive reaction for tellurium. If a little of it is poured into a hydrogen gas apparatus containing zinc and dilute sulphuric acid, and the hydrogen given off, which is mixed with hydrogen telluride, is passed into undiluted telluriferous sulphuric acid, the liquid, previously colourless, quickly takes the red colour of tellurium sulph-oxide. If the gas containing hydrogen telluride is passed in for a sufficient time, the red sulph-oxide is destroyed, and a brown substance separates, which sometimes also appears as foliaceous or crystalline black particles of metallic lustre. The destruction of the sulph-oxide can either take place by reduction or by decomposition into sulphuric anhydride and tellurium, the latter forming a per-telluride with the hydrogen telluride. The more probable case of reduction would involve the liberation of sulphurous acid, but as the quantities of the tellurium compounds are relatively very small this gas cannot be detected by its odour. If the gases are passed into solution of permanganate sulphuric acid can be very easily afterwards detected in the liquid. But no sulphurous acid can be shown in this manner so long as the red sulph-oxide is produced during the first action of the hydrogen telluride. Hydrogen telluride has no action upon pure sulphuric acid, at least not immediately, and pure hydrogen has no action upon telluriferous sulphuric acid.

The black-brown precipitate cannot be free tellurium on account of its brown colour, but principally because tellurium is soluble in that state in which it would here have arisen. The precipitate, indeed, re-dissolves in sulphuric acid, but only under certain circumstances. It dissolves quickly with a red colour in sulphuric acid containing tellurium dioxide. It dissolves less readily if fresh sulphuric acid is added to that from which it has been deposited. In this case the sulphuric acid probably exerts an oxidising action, because it contains traces of dissolved oxygen or oxidising agents. It dissolves in the supernatant sulphuric acid, from which it has been precipitated when the mixture is exposed to the air, the re-solution proceeding from the surface of the liquid downwards. Solution occurs also, though more slowly, when the precipitate with the supernatant acid is sealed up in glass tubes filled with hydrogen. Sulphuric acid is then reduced, since on opening the tubes the odour of sulphurous acid is perceptible. This is a fresh proof that the precipitate is not free tellurium, which dissolves without forming sulphurous acid.

These reactions of the brown deposit lead to the conclusion that it is a hydrogen per-telluride, the hydrogen of which is quickly oxidised by the air in presence of sulphuric acid, or more slowly by sulphuric acid alone, which is thereby reduced to sulphurous acid.

Not merely hydrogen per-telluride, but the red sulphoxide is slowly oxidised by sulphuric acid. Sulphuric acid coloured deeply red by tellurium is slowly decolourised, even in sealed tubes. It is a well-known fact that this takes place on the application of heat. If the sealed tubes are opened after their contents have become colourless the odour of sulphurous acid is distinct.

If hydrogen containing hydrogen arsenide, phosphide, or selenide is passed into sulphuric acid in which tellurium sulphate is dissolved the sulphuric acid likewise takes a red colour, and becomes colourless after depositing dark-brown precipitates. In case of hydrogen phosphide the deposit is black.

Selenious acid dissolved in sulphuric acid gives the same reactions as tellurous acid, but less rapidly, and the changes of colour are less striking.—*Berichte der Deutschen Chemischen Gesellschaft*.

SEPARATION OF GALLIUM FROM IRIDIUM.

By M. LECOQ DE BOISBAUDRAN.

THE author indicates four procedures :—

1. The solution containing the iridium in the state of tetrachloride is mixed with from one-fourth to one-third its volume of strong hydrochloric acid, and then with a small excess of potassium ferrocyanide. The precipitate contains the gallium as well as traces of iridium, which are removed by re-dissolving in caustic potassa, acidifying strongly with hydrochloric acid, and treating with ferrocyanide. The operation is repeated twice or thrice.

2. Cupric hydrate precipitates gallium sesquioxide from a hot solution in presence of iridium tetrachloride, but a noteworthy quantity of the latter is found in the galliferous solution after removal of the copper by means of hydrogen sulphide. The iridium may, however, be got rid of by six or seven successive treatments with cupric hydrate.

3. Metallic copper and cuprous oxide may also be used, avoiding too large an excess of the latter. Five or six successive operations are needed to eliminate the iridium.

4. The following method, founded upon certain reactions of iridium recently described (*Comptes Rendus*, May, 1883, pp. 1336, 1406, and 1551) may be recommended:—The chlorides or sulphates of gallium and iridium are mixed with a decided excess of potassium bisulphate. The mass, which must be contained in a vessel of gold, is evaporated, and heated to dull redness. When this temperature is reached the fire is removed. The saline matter is then dissolved in boiling water. The liquid, which is green, blue, or violet, is almost neutralised in the cold with potassa or potassium carbonate. It must, however, remain sufficiently acid to be sensitive to litmus. A large part of the iridium is deposited with the neutral potassium sulphate, which it colours green, whilst almost all the gallium remains in solution. The sediment is washed with water containing neutral potassium sulphate, and very slightly acidulated with sulphuric acid. The collected liquid, almost neutralised with potassa, is boiled in contact with the air from fifteen to thirty minutes. It is then, whilst hot, supersaturated with a slight excess of potassa, and kept nearly at a boil for fifteen to thirty minutes longer. The iridium oxide being collected on a filter, the gallium is extracted from the liquid by the means formerly indicated for its separation from the alkalies. In order to free the iridium oxide from the last traces of gallium it is re-dissolved in dilute sulphuric acid, and re-precipitated, hot, with a slight excess of potassa. This operation may be twice or thrice repeated. The iridiferous potassium sulphate retains little or no gallium. It may, however, be

treated in the same manner as the mother-liquor, by solution in water, quasi-neutralisation, boiling with contact of air, and supersaturation with potassa.

It is often useless to effect the separation of the greater part of the iridium in the form of a combination with neutral potassium sulphate. The approximate neutralisation of the original liquid is then effected whilst still hot and sufficiently dilute not to deposit potassium sulphate on filtration.—*Comptes Rendus*.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON, FOR THE MONTH ENDING MAY 31ST, 1883.

By WILLIAM CROOKES, F.R.S.

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford.

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

London, June 5th, 1883.

SIR,—We desire to submit, for the information of the Local Government Board, a statement of the particular and general results of our examination, made at the expense of the Water Companies, of 182 samples of water, collected by us during the past month at the times and places indicated, from the mains of the seven London companies taking their supply from the Thames and the Lea.

We are, Sir,
Your obedient Servants,

WILLIAM CROOKES,
WILLIAM ODLING,
C. MEYMOTT TIDY.

To the Secretary of the Local Government Board.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from May 1st to May 31st inclusive. The purity of the water, in respect of organic matter, has been determined by the Oxygen and the Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted for analysis.

Of the 182 samples of water submitted to examination, the whole without exception were clear, bright, and well filtered; and their condition in respect to aëration, and to freedom from colour and excess of organic matter, was unimpeachably excellent.

THE LUMINOSITY OF NON-ILLUMINATING GAS FLAMES.

As the illuminating power of gaseous flames is known to be due to the presence of incandescent solid or even liquid particles, it has been customary to say that the feebly luminous flame of gases which do not contain such particles is the effect of the incandescence of the gas itself at a high temperature. Dr. Werner Siemens had an idea that pure gases, however highly heated, did not emit light; and he has recently carried out a series of experiments to determine this question. In order that an experiment of this

nature should be decisive, the observed temperature should be higher than that produced by luminous combustion. Dr. Werner Siemens therefore had recourse to the regenerative furnace used by his brother Friedrich Siemens, of Dresden, in the manufacture of hard glass. The furnace stands in a separate room, which can be made perfectly dark. In the walls of the furnace are two openings opposite each other, thus allowing free vision through. A heat of 1500° or 2000° C. (or beyond the melting temperature of steel) can easily be obtained. Before the sight-holes were placed a series of smoke-blackened screens, with central openings so proportioned to the holes in the furnace that the observer could look through the latter without receiving any rays from the heated walls. If under these conditions dampers were closed, and all light excluded from the room, it was found that not the least light came to the eye from the highly-heated air in the furnace. For the success of the experiment it was necessary to avoid any combustion in the furnace, and then wait until the enclosed air was as free from dust as possible. Any flame in the furnace—even when not in the line of sight, or the least quantity of dust in it, illuminated the field of vision.

As a result of these experiments, Dr. W. Siemens considers the view hitherto held, that highly-heated gases are self-luminous, is not correct. In the furnace were, in this instance, the products of the previous combustion of the fuel with atmospheric air; or a mixture of oxygen, nitrogen, carbonic acid, and aqueous vapour. If only one of these gases had possessed the property of being self-luminous, the field of vision must have been always illuminated. The weak light of burning gases wherein there is no separation of solid particles cannot, therefore, be considered as a phenomenon of the glow of the gaseous products alone. It further occurred to Dr. W. Siemens as probable that heated gases do not emit heat rays. After again convincing himself and Dr. Herr Fröhlich, of Dresden, that the heated gases were perfectly dark, Dr. W. Siemens's thermopile experiments for the investigation of the other hypothesis failed. By the aid of a common lamp, however, it was found that heated gases do radiate some heat, but much less than some solid bodies at the same temperature. Dr. W. Siemens does not yet say what he believes to be the cause of the feeble light of so-called non-luminous gases.—*Journal of Gas Lighting*.

ON THE ACTION OF CERTAIN VEGETABLE ACIDS ON LEAD AND TIN.*

(Concluded from p. 291).

By FRANCIS P. HALL.

It was suggested that the galvanic action would influence more the rapidity of the corrosion than the total amount of metal dissolved; hence that the effect would be more clearly marked at the end of two days than at the end of two weeks, but experiment showed that this is not the case. For this experiment I used only one of the alloys, namely that containing the most tin: the results are recorded in Table II. While the amount of action is not exactly proportional to the time of exposure, it is not far from being so in the case of acetic acid, and in the case of citric and tartaric acids it is evident that the action is very slight at first and increases appreciably as time goes on.

In these experiments, although the metal was covered with the acid and the beaker with a watch-glass, the air had more or less free access to the surface of the liquid. To see what effect the air had on the corrosion, and to approach more nearly the conditions of a sealed can, I took some glass stoppered bottles and repeated the experiment in them. I weighed the strips of metal as before

and placed them in the bottles, then heated the bottles on steam cups, and while hot filled them with the acid, also heated to boiling to expel any air. The bottles were at once tightly stoppered. As they cooled a few of them leaked a little, but as it was nearly full of liquid very little air could enter. They were put in the same place as in the former experiments and left for two weeks. On being examined at the end of this time there was evidently much less corrosion than in the case of the corresponding experiments in open beakers. There was no discolouration, and no crystals formed. That the air had been pretty well excluded could be seen from the way the stoppers stuck in the bottles even after they could be turned with ease. The same difference in the character of the precipitates of sulphide of tin was noticed as before.

The results are given in Table III. (See next page.)

It will be noticed that the corrosion was considerably less. For convenience I give a Table showing the comparative results obtained in open and closed vessels.

TABLE IV.

Dissolved from	By Acetic Acid.		By Tartaric Acid.		By Citric Acid.	
	Open.	Closed.	Open.	Closed.	Open.	Closed.
Lead ..	0.4216	0.0886	0.0542	0.0343	0.3521	0.0510
Alloy ..	0.3744	0.0341	0.0298	0.0102	0.1628	0.0267
Tin ..	0.2906	0.0446	0.0212	0.0057	0.1264	0.0134

The acids used were of about the strength of good vinegar. It would naturally be supposed that less strong acids, such as usually occur in canned goods, would cause correspondingly less corrosion. This does not seem to be the case; an incomplete series of experiments seem to indicate that a dilute acid, if used in sufficient quantities, causes much more corrosion than would be inferred from its strength.

To try now the action on the cans themselves, and also the effect of the solder, I took three cans that had been emptied and put 200 c.c. of acid into each—acetic acid in one, tartaric acid in another, and citric acid in the third. I covered these cans as well as I could by tying two thicknesses of paper over each, but of course they were practically open cans; moreover the acid did not nearly fill them. They would represent, therefore, a can that had been partly emptied and sent away, rather than a fresh one. When examined at the end of two weeks, the tinning up as far as the acid reached was entirely taken off, except in the acetic acid. The citric acid had a yellowish colour, and a quantity of white powder was deposited on the bottom of the can. I emptied the acid from the cans and added a few drops of chlorhydric acid, fearing that the organic acid was not sufficient to hold up the sulphide of iron. The addition of chlorhydric acid and a little warming dissolved the white powder in the citric acid, and at the same time destroyed the yellow colour. On passing sulphuretted hydrogen through the solutions, a very large precipitate was obtained. This I filtered off, washed, and treated with ammonium sulphide; the residue was collected on a filter, dissolved in strong chlorhydric acid, and after evaporation the lead was precipitated as sulphate.

The tin was determined in the ammonium sulphide solution. The result was as follows:—

Acetic acid dissolved	0.4178	grm. of tin and	0.0117	of lead.
Tartaric „ „	1.0430	„ „	0.0873	„
Citric „ „	0.6828	„ „	0.1559	„

In addition to the lead and tin there was a good deal of iron dissolved.

This shows that corrosion takes place very rapidly after a can is opened, and that a can once opened should be emptied at once. One would have supposed that the acetic acid would have acted more than the others; and it probably would if the conditions in the different cans had been exactly the same. It is probable that more solder was exposed in the cans treated with tartaric and citric

* *American Chemical Journal*, vol. iv., No. 6.

TABLE II.

Kind of Acid.	Surface exposed, in sq. inches.		Percentage composition.		Loss of weight, in grms.	Found in solution, in grms.		Percentage of dissolved metals.		Total amount dissolved (in grms.) from	
	Lead.	Tin.	Lead.	Tin.		Lead.	Tin.	Lead.	Tin.	Alloys.	Pure Metals.
Acetic ..	7'2	—	100'0	—	0'0515	0'0497	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0460	0'0046	0'0387	10'62	89'38	0'0433	0'0896
„ ..	—	21'6	—	100'0	0'0400	—	0'0399	—	—	—	—
Tartaric ..	7'2	—	100'0	—	0'0400	0'0374	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0120	0'0012	0'0124	8'82	91'82	0'0136	0'0470
„ ..	—	21'6	—	100'0	0'0255	—	0'0096	—	—	—	—
Citric ..	7'2	—	100'0	—	0'0625	0'0599	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0215	0'0015	0'0218	6'44	93'56	0'0233	0'0817
„ ..	—	21'6	—	100'0	0'0120	—	0'0218	—	—	—	—

TABLE III.

Acetic ..	7'2	—	100'0	—	0'0900	0'0886	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0365	0'0052	0'0289	15'25	84'74	0'0341	0'1332
„ ..	—	21'6	—	100'0	0'0430	—	0'0446	—	—	—	—
Tartaric ..	7'2	—	100'0	—	0'0365	0'0343	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0085	0'0018	0'0084	17'65	82'35	0'0102	0'0400
„ ..	—	21'6	—	100'0	0'0080	—	0'0057	—	—	—	—
Citric ..	7'2	—	100'0	—	0'0560	0'0510	—	—	—	—	—
„ ..	7'2	21'6	34'1	65'9	0'0250	0'0018	0'0249	6'74	93'25	0'0267	0'0644
„ ..	—	21'6	—	100'0	0'0120	—	0'0134	—	—	—	—

acids; at any rate the lead must have come from the solder, as the tin from which the cans were made proved, on being tested, to be free from lead.

On the Quality of Commercial Tin-plate.

Having seen the action of some of the more common vegetable acids on lead and tin, and the alloys of the same, we come to the tin-plate itself.

The tin plate used in America is entirely imported, most of it from England. The two principal kinds are "Bright plate" and "Terne plate." Bright plate is, or should be, tinned only with pure tin. It is divided into several grades, according to the thickness of the tinning and the quality and heaviness of the iron which forms the basis, but in all these grades the tinning is supposed to be pure tin. Terne plate, on the other hand, is known to contain large quantities of lead, and is often called lead-plate, there being no attempt to pass it for tin, at least by respectable persons.

Tinware and fruit-cans are made from bright plate, while terne plate is used altogether for roofing. Of course the boundaries are sometimes overstepped; those who are very particular use bright plate for roofing, and those who are too avaricious may make tin-ware out of terne plate. This last, I think, however, is very seldom the case, and the heavy nature of terne plate unfits it for canning.

Knowing these divisions of tin-plate, the questions before us now are: Is bright plate, especially that used in canning, always tinned with pure tin? and how commonly is terne plate used where it will come in contact with food.

I procured some specimens of plate through the kindness of one of the largest importing houses in the city. These I tested by several methods. With the bright plate, taking small pieces, I could find no lead at all, and only after taking half a square foot did I find a trace. This was no more than would be found in most English bar-tin. I now tested a number of cans from various sources, as well as the worst-looking tinware from the so-called 5-cent stores, but not once did I find enough lead to show an intentional adulteration. Neither have I found any well instituted attack on the character of the tin-plate in this country. A good deal has been said and many suspicions thrown out, but the only statements of analyses that I have seen are in a Board of Health report of a Western

State.* The author found lead so invariably in all tin articles that came into his hands that one cannot help suspecting that the methods of analysis were unreliable. He even observes that he found a considerable quantity of lead in what was sold for pure tin—a thing quite possible, it is true, but not likely to happen with dealers to whom a chemist would naturally go for pure supplies.

Even if the tin of the can is pure, there remains the solder, which always contains a large quantity of lead, and is used very freely. There remains, also, the fact that the vegetable acids act considerably upon tin itself. There are many published statements as to the presence of tin in canned goods, and the careful inspection of the inside of a can which has contained an acid fruit shows quite clearly in many cases that corrosion has taken place. Moreover, although my experiments tend to show that the amount dissolved when the air is excluded is much less than when open, still it is an appreciable quantity; and if, as seems to be the case, the amount increases with the time, that dissolved from an old can must be considerable.†

The terne plate, which is that most often used for roofing, cannot be considered quite harmless in cases where the water from the roof is used for household purposes. But as the tin roof as well as the whole house is generally covered with a paint containing far more lead than the terne plate itself, it would be absurd to complain while we use white-lead to such an extent as at present.

I made a rough analysis of the tinning of terne plate by dissolving it off with chlorhydric acid, precipitating the lead and tin as sulphide and separating them with sulphide of ammonium. The result was as follows:—One-fifth of a square foot gave 1'1650 grm. of lead and 0'4469 grm. of tin, which would make the tinning consist of 72'27 per cent of lead and 27'73 per cent of tin. Terne plate can be readily told by its dulness; it comes also in larger sheets than bright plate.

Although constantly on the watch for tinware made of terne plate, I have been able to find none. I am informed on good authority, however, that it is sometimes used for that purpose, but conclude that such use must be rare in this section of the country.

* "Mich. Board of Health Report," 1878, p. 29.

† It is hardly to be supposed that the proportion indicated by the above experiments continues indefinitely.

TABLE V.

No.	Amount taken.		Amount found, in grms.		Percentage.	
	Size in sq. in.	Weight in grms.	Tin.	Lead.	Tin.	Lead.
1.	6	0.2285	0.2275	—	99.53	—
2.	6	0.4260	0.4227	—	99.23	—
3.	6	0.5950	0.5929	—	99.65	—
4.	6	0.5150	0.1162	0.3945	22.56	76.60
5.	6	0.9080	0.0902	0.8152	9.94	89.95
6.	6	0.7140	0.1642	0.5464	23.00	76.41
7.	6	2.0785	0.0839	1.9860	3.86	95.75
8.	6	1.8580	0.1172	1.7360	6.31	93.43
9.	6	0.3030	0.1125	0.1819	37.44	60.03
10.	2.25	0.4720	0.1078	0.3678	22.84	77.94
11.	3	0.8005	0.2004	0.5969	25.03	74.55
12.	6	1.4940	—	1.2240	—	81.92

TABLE VI.

21.	6	0.2650	0.2653	—	100.10	—
22.	6	0.5145	0.5130	—	99.70	—
23.	6	0.2560	0.2559	—	99.96	—
24.	6	1.1175	0.1111	1.0040	9.94	89.87
25.	—	1.1600	0.2570	0.8733	22.15	75.27
26.	—	0.7915	0.1645	0.5793	20.77	73.19
27.	6	0.4435	0.4419	—	99.63	—
28.	2	0.4850	0.0338	0.3879	19.34	79.99

On Commercial Tin-foil.

Tin-foil is so much used now-a-days on chocolate, compressed yeast, cheese, and the like, that I thought the analysis of a few samples might not be amiss. Here at the outset we have a good proof of adulteration, from the fact that the price of most foil is but little more than half the price of pure bar tin.

I collected a number of samples from different importers and manufacturers. They varied greatly in thickness, colouring, and design, but I had reason to suppose that many were the same in composition. I took what I thought was a fair sample of them as regarded composition, and analysed them.

The method used was that usually used for solders, the oxidation with nitric acid. It was not thought necessary to correct for the trace of lead retained by the oxide of tin; neither were traces of copper or other metals sought for, which even if present would hardly influence the character of the foil, at least as far as sanitary purposes were concerned. The results of the analyses will be found in Table V. I give in the table the size of the piece of foil taken for analysis, its weight, and the weight of the lead and tin found in it, as well as the percentage composition. Only the first three foils were sold for pure tin. Some were sold as "composition foils," but generally, unless special inquiry was made, nothing was said of their composition.

In order to see if I had had a fair sample of the foils in general use, and to see which of them were most used on articles of food, I took several foils that had been in actual use and analysed them. The results appear in Table VI. It will be seen that each corresponds very nearly to some one in Table V. Nos. 21, 23, and 28 were on chocolate; Nos. 22 and 27 on different kinds of compressed yeast; Nos. 25 and 26 on "Neuchâtel" cheese; No. 24 on the outside of a box of troches. No. 23 was on a small cake of chocolate bought at a street stand, while No. 28 was

an embossed foil and on a very fashionable cake of chocolate. No. 25 was very brittle and showed signs of being acted upon. The cheese was quite acid to litmus.*

Mass. Inst. of Technology, Boston, Mass.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 21, 1883.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

A BALLOT was held, and the Scrutators, Dr. Thorne and Mr. Meldola, declared the following gentlemen duly elected Fellows of the Society:—G. S. Bowler, C. Beringer, T. H. Coleman, A. Esilman, H. E. Harrison, C. Hulke, H. Heap, B. Hobbs, C. T. Heycock, W. J. Livingston, B. P. Lascelles, H. R. Mill, M. F. Purcell, J. E. Richardson, F. G. Roberts, W. R. Reffell, A. Smith, E. H. B. Stephenson, A. W. Soward, A. H. Samuel, D. Wilson, R. Williams.

The PRESIDENT then called on Prof. McLEOD to read a paper "*On Evaporation in Vacuo.*"

The ordinary method of evaporation *in vacuo* over sulphuric acid is very slow, for three reasons:—The aqueous vapour reaches the surface of the acid by diffusion only; the surface of the sulphuric acid is limited, and as the dilute sulphuric floats on the concentrated acid, the absorption of aqueous vapour is much retarded; lastly, heat is supplied but slowly to the evaporating liquid, being almost entirely that reaching it by radiation. In one experiment 50 c.c. of water placed *in vacuo* over 250 c.c. of sulphuric acid required two-and-a-quarter days for complete evaporation. The author was led to try some experiments on the evaporation of water at low temperatures by some remarks of Prof. Mallet (CHEMICAL NEWS, vol. xlv., 62, 73, &c.), and the method was suggested by Wright's apparatus for the distillation of mercury (*Ibid.*, xlv., 311). A somewhat similar apparatus is described by Mallet (*Ibid.*, xlvii., 218, 252). The author used a Körtling's

* The use of a foil containing about 75 per cent of lead for wrapping the so-called Neuchâtel and other soft cheese is certainly reprehensible. Owing to the acid in, or developed in, the cheese the foil becomes crumbly, and even when the cheese is first covered with greased paper, particles of the oxidised foil are very likely to become attached to the cheese as it is used. Attention has been repeatedly called to this matter abroad, among others by Wittstein (*Dingler's Polyt. Journ.*, 208, p. 341), who found appreciable amounts of lead in cheese thus wrapped.

jet-pump to produce the vacuum. In one form of apparatus the water was evaporated in a glass dish with ground top, which pressed a red india-rubber ring against a brass ring soldered to a copper dome. The aqueous vapour was condensed in a copper vessel consisting of a truncated cone within a cylinder. The tube by which the water to be evaporated is supplied ends in a small glass funnel, the mouth of which touches the inside of the dish. The dish is surrounded by a water-bath at 50° . The temperature of the water in the dish was found to be 26° : 50 c.c. of water can be evaporated in two hours. Instead of the dish the author has used a wide test-tube, or a combustion-tube, so that the water residue can be evaporated in the tube afterwards used for effecting its combustion. In another modification described by the author the condenser is replaced by a wide vertical tube, down the inner surface of which a thin layer of sulphuric acid is allowed to flow. The aqueous vapour is thus rapidly absorbed, and passes down the fall-tube as dilute sulphuric acid. It is necessary to cool the sulphuric acid by a flow of cold water. The author exhibited this apparatus at work, and incidentally described a useful valve for preventing the loss of a vacuum, which occurs when using K rting's pump, if the water pressure be suddenly diminished. The stream of water passes down a narrow glass tube into an elongated bulb, from the bottom of which it issues by a T-piece. In this bulb floats a piece of glass tube filled with air and closed at both ends, so that it just floats in water. The upper end of this float is ground, so that if the water stream stops the float rises and stoppers up the narrow glass tube: the vacuum is thus preserved.

Mr. THORP said the paper was of great interest to water analysts. He was afraid that it might be difficult to mix the water residue in the combustion tube perfectly with oxide of copper, and there seemed to him a possibility of the introduction of small pieces of india-rubber.

Dr. ROSCOE then communicated a paper "*On the Preparation of the Pentathionates*," by S. SHAW. Professor Spring (*Annalen*, 213 [3], 329) expresses doubts as to the existence of pentathionic acid and the pentathionates, and especially combats the statements of Lewes (*Chem. Soc. Jour.*, March, 1881), who prepared and analysed the potassium and barium salts. The author therefore repeated Lewes's work, and has been able to confirm completely his results. He has succeeded in preparing perfectly clear transparent crystals of potassium pentathionate, which can be re-crystallised, which differ in form from the tetrathionate, and give a white precipitate of sulphur when treated with caustic potash. On analysis they were proved to contain 2 atoms of potassium to 5 of sulphur.

Appended to this paper is a "*Note on Pentathionic Acid*," by WATSON SMITH. In it it is proved that Wackenroder solution prepared with excess of sulphur dioxide does not bleach dilute indigo solutions. When to half-neutralised Wackenroder solution caustic potash is added no precipitate is produced, because in the presence of free sulphurous acid thiosulphate is formed. If, however, the solution be evaporated the sulphur dioxide is expelled, and the sulphites and thio-sulphates are decomposed. A liquid is then obtained, which gives with caustic potash a precipitate of sulphur from the decomposition of the pentathionates.

Dr. DEBUS said that Mr. Lewes was still working at the subject, and had obtained crystals of potassium pentathionate more than an inch in length. The pentathionates could only be prepared and re-crystallised from acid solutions. If one-half of a solution was neutralised and the other half added the pentathionates were decomposed. The quantity of base required must be calculated, and then added to the acid solution.

Dr. ARMSTRONG then read a "*Note on Hydrocarbons from Camphor*." The author in a previous communication (December, 1877) announced that he was engaged in an examination of the mixture of hydrocarbons produced by the action of several of the so-called dehydrating agents on camphor. Owing to the complex character of

the product the time occupied in fractional distillation, &c., but little progress had been made in the research. During the last few months, however, the author has, in conjunction with Dr. Miller, repeated the whole of the previous work on a very large scale, and satisfactory methods of separation have been devised, so that it will soon be possible to publish a complete account of the investigation. An exhaustive study has been made of the actions of phosphoric anhydride, phosphorus penta-sulphide, zinc chloride, and of iodine. The author gave some account of the action with zinc chloride. After describing the method of operating and separating the products, he stated that in the main C_{10} compounds are produced under the conditions which have been maintained in carrying out the reaction. The phenol produced is carvacrol, and the chief constituents of the hydrocarbon mixture are $C_{10}H_{20}$ and two $C_{10}H_{14}$ hydrocarbons; relatively small quantities of both higher and lower homologues of $C_{10}H_{14}$ are also present, together with one or two hydrocarbons, which are carbonised by sulphuric acid, and are not yet satisfactorily identified. The two $C_{10}H_{14}$ hydrocarbons are isomers of cymene; the barium salt of one of these is almost insoluble in water, the sodium salt crystallising with one molecule of water in large nacreous plates. The barium sulpho-salt of the other hydrocarbon is easily soluble and closely resembles ordinary barium cymene sulphonate, with which previous observers have identified it. For a long time the author of the present note was similarly mistaken. The salt, however, contains $3\frac{1}{2}$ molecules of water of crystallisation, and is convertible into a magnesium salt, which is highly characteristic, and is altogether different from ordinary magnesium cymene sulphonate. Although two other easily soluble barium sulpho-salts, derived from $C_{10}H_{14}$ hydrocarbons, have been isolated, one crystallising with 9 molecules of water in long flat prisms, the other with $7\frac{1}{2}$ molecules in small glistening plates, no indication of the presence of ordinary cymene in the product from the action of zinc chloride has been obtained. A not inconsiderable quantity of camphorone, $C_9H_{12}O$, is also produced. The product of the action of iodine on camphor does not contain cymene, but yields the sulpho-salt resembling that of ordinary cymene referred to above.

In answer to Dr. TILDEN,

Dr. ARMSTRONG said that he was quite satisfied that the hydrocarbons were $C_{10}H_{14}$, and not $C_{10}H_{16}$ hydrocarbons.

Mr. V. H. VELEY then read a paper "*On the Rate of the Decomposition of Ammonium Nitrate*." The author has carefully measured the rate at which gas is evolved by heating pure ammonium nitrate at a constant temperature. He has arrived at the following conclusions:—That the rate of decomposition into nitrous oxide and water is dependent, not only on the mass of the salt, but on the proportion of free nitric acid present. If the reaction of the salt be rendered alkaline, the rate gradually increases as the proportion of free acid increases; a period of maximum velocity is then reached corresponding to the greatest proportion of free acid; the rate then slowly decreases with the decrease of free acid. An excess of ammonia completely stops the reaction, even when the temperature is raised 50° or 60° above the normal temperature of decomposition. If the reaction of the salt be rendered acid at starting, the rate of decomposition gradually decreases as the acid decreases. After heating the salt for thirteen to sixteen hours, the rate of change becomes practically constant. The apparatus used in the research was exhibited, and the method illustrated before the Meeting by the author.

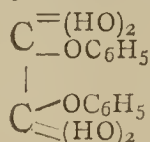
Prof. RAMSAY then shortly described and exhibited a new gas burner for heating combustion tubes. The burner consists of a Bunsen burner, on the top of which fits a brass T-piece. The top of the T is about 6 inches long and 1 inch in diameter. It has a longitudinal slit cut in it on the top. The ends are closed by pieces of sheet-brass, which are arranged so that they support the tube to be

heated. By a simple arrangement any third of the slit can be closed or opened. A series of these tubes can be connected together by a bayonet catch, so that any length of tube can be supported and heated. The tube is covered by a length of asbestos cardboard. The principal advantages are that the arrangement is cheap and cools quickly, so that seven combustions can be performed in a day.

The two following papers were taken as read:—

"*Note on the Action of Allylic Iodide upon Phenol in the Presence of Zinc or Aluminium Foil*," by P. T. FRANKLAND and T. TURNER. A colourless liquid was obtained, boiling at 223° to 225°. It proved to be ortho-propylphenol.

"*On a By-product of the Manufacture of Aurin*," by A. CLAPAREDE and WATSON SMITH. When aurin is prepared from phenol, oxalic acid, and sulphuric acid, a quantity of white crystals are found on the lids of the aurin pots. The authors have purified and analysed these crystals, which consist of a phenyl-ortho-oxalic ether,—



This substance melts at 123° to 124°. It is formed when phenol and anhydrous oxalic acid are distilled together.

The Society then adjourned over the summer recess.

PHYSICAL SOCIETY.

Saturday, June 23rd, 1883.

Prof. CLIFTON, President, in the Chair.

NEW Member—Mr. Stearn.

Prof. D. E. HUGHES, F.R.S., exhibited a number of experiments illustrating his theory that a magnet is made up of magnetic molecules, each of which is a small magnet. When a magnetic metal is in a neutral state, he showed that there is a symmetrical arrangement of the molecules, such as to make them satisfy their mutual attractions; not, as on Ampère's theory, a "higgledy-piggledy" arrangement.

Prof. GUTHRIE stated that a piece of watch spring magnetised retains its magnetism when impregnated with mercury. He also illustrated the distinction between "higgledy" and "piggledy."

Prof. EVERETT, Mr. W. H. COFFIN, and others, remarked that Ampère's theory tried to account for the magnetism of the molecules.

Profs. PERRY and AYRTON stated that when soft iron is between red- and white-hot, it ceases to be attracted by a magnet.

The new Absolute Sine-Galvanometer of Prof. Minchin was then exhibited to the meeting by Prof. G. CAREY FOSTER. It is intended for the Cornell University, and measures less than the E.M.F. of a Daniell cell. The principle of the instrument was described at a former meeting of the Society.

Prof. AYRTON, Lord RAYLEIGH, Mr. COFFIN, and Prof. CLIFTON offered some remarks on the apparatus.

A "*Note on the Induction Balance Effect, and the Densities of Alloys of Copper and Antimony*," by Mr. GEORGE KAMENSKY, A.R.S.M., was then explained by Prof. CHANDLER ROBERTS. These experiments were to determine whether the curve of the electrical resistance of the copper-antimony alloys would be a straight horizontal line, U-shaped, or of the L type. It was found to belong to the last type. It is seen from the curve exhibited that there is a rapid fall from copper to the alloy containing only 10 per cent antimony, and this decrement is continued until the alloy SbCu₄ is reached, when the curve turns rapidly and rises to SbCu₂, then turns again and passes to pure antimony. Prof. Roberts has shown that the alloy SnCu₄ occupies the low est point

of the curve, namely, the position that in the copper-antimony series is occupied by the alloy SbCu₄. In the copper-tin series the second critical point is held by SnCu₃, and in the copper-antimony curve this point is held not by Cu₃Sb, but Cu₂Sb, the formula for the violet alloy known to alchemists as the "regulus of Venus." The specific gravities were also plotted in curves, showing that the alloy Cu₂Sb does not stand out from the rest, while the alloy Cu₄Sb has a higher density than copper.

OBITUARY.

DEATH OF MR. SPOTTISWOODE.

WE regret to announce the death of Mr. Spottiswoode, LL.D., President of the Royal Society, which took place on Wednesday morning last at a quarter past eleven o'clock.

Mr. Spottiswoode was born in January, 1825, and was consequently in his fifty-ninth year. He was educated at Dr. Buckland's school at Laleham, and afterwards at Eton, and at Harrow under Dr. Wordsworth. He entered Balliol College, Oxford, in 1842, graduated B.A. as a first-class in mathematics in 1845, and gained university mathematical scholarships in 1846 and 1847. On leaving Oxford he took the management of the business of the Queen's printer, but he continued his studies in mathematics, philosophy, and languages; was elected a Fellow of the Astronomical, Royal, Geographical, Asiatic, and Ethnological Societies, and of the Society of Arts. In 1857-58, Mr. Spottiswoode was Public Examiner in Mathematics at Oxford, and he has acted as examiner under the Civil Service Commission, for the Society of Arts, and for the Middle Class Schools. He was appointed Treasurer of the Royal Society in 1871, and was elected President in 1878. He was also elected President of the British Association in the same year, at the Dublin meeting, when the University of Dublin conferred on him the honorary degree of LL.D. A similar degree had in 1871 been conferred on him by the Edinburgh University.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcvi., No. 23, June 4, 1883.

The Solubility of Copper Sulphide in the Alkaline Sulpho-molybdates.—M. Debray.—The product of the action of sulphuric acid upon cerite, re-dissolved in water, gives a liquid which is more or less abundantly precipitated by hydrogen sulphide. The blackish precipitate contains copper, lead, bismuth, and tungsten, and also molybdenum,—a fact of little importance if the detection of molybdenum in presence of copper did not present an interesting singularity. On digesting the well-washed precipitate of sulphide with ammonium sulphide there is produced a deep-brown liquid, from which dilute hydrochloric acid precipitates a reddish body, which filters badly. If this precipitate is roasted at a low temperature, it yields a brown substance, which melts at a red heat, and crystallises on cooling like vanadic acid, but which is copper molybdate. On melting it with dry sodium carbonate and re-dissolving in water, there is obtained a black residue of copper oxide and soluble sodium molybdate. This compound, if produced by double decompo-

sition is very easily fusible at redness, with disengagement of oxygen, because a certain quantity of cuprous molybdate is produced. Copper sulphide may also be dissolved in an alkaline sulpho-molybdate, which, on the addition of hydrochloric acid, gives the reddish precipitate above mentioned. The quantity of sulphide which may thus be dissolved in the alkaline sulpho-molybdates is very considerable, corresponding to the formation of a definite copper sulpho-molybdate.

An Apparatus for Obtaining Low Temperatures Capable of being Regulated at Will.—P. Gibier.—This paper requires the two accompanying diagrams.

Phosphorus Sub-sulphides.—M. Isambert.—The author has repeated the experiments of Berzelius and Dupré on the lower sulphides of phosphorus. He agrees with these chemists as to the facts observed, but considers that their interpretation must be completely modified. He finds that phosphorus is a solvent for sulphur and phosphorus sulphide, P_2S_3 , which remains liquid even below its melting-point. Ordinary phosphorus is rapidly converted into red phosphorus if heated in presence of a small quantity of phosphorus sesquisulphide.

Phosphorus Sesqui-sulphide.—G. Lemoine.—The author, referring to the paper of M. Isambert's, inserted in the *Comptes Rendus* of May 21, 1883, calls attention to the fact that most of the experiments therein described had been already published by him in the *Comptes Rendus*, May 16, 1864, and in his "Theses for the Doctorate of the Faculty of Sciences of Paris," June 15, 1865, from which he makes quotations.

Freezing-point of Acid Solutions.—F. M. Raoult.—The author gives tables of the lowering of the freezing-point occasioned by adding 1 grm. of various acids to 100 grms. of water. He has established that the sulphurous, iodic, phosphorous, arsenious, and arsenic acids are almost entirely expelled from their alkaline salts in dilute solutions by a quantity of hydrochloric or nitric acid sufficient to saturate the base.

Thermic Study on the Solution of Hydrofluoric Acid in Water.—M. Guntz.—The author examines the solution-heat of gaseous and of liquid hydrofluoric acid, the volatilisation-heat of liquid hydrofluoric acid, and the dilution-heat of the same acid in different states of concentration.

Transformation of Glycolide into Glycolic Acid.—M. de Forcrand.—A thermo-chemical study. The transformation is exothermic, setting out from liquid water, but endothermic if we set out with solid water.

Researches on the Production of Crystalline Borates by the Moist Way.—A. Ditte.—The author has succeeded in obtaining several groups of well-crystallised borates, a description of which will appear on a future occasion.

Reactions of Lead Sulphide upon the Metallic Chlorides.—A. Levallois.—The author has experimented with the chlorides of magnesium, aluminium, zinc, silver, antimony, and gold, ferric, mercuric, stannous, stannic, and platinic chlorides. All these compounds react rapidly upon lead sulphide. Even magnesium chloride, in the absence of any trace of free hydrochloric acid yields needles of lead chloride.

Baking of Plaster.—H. Le Chatellier.—The author studies the various hydrates of gypsum and their tensions of dissociation.

An Acid obtained by the Oxidation of Strychnine.—M. Hanriot.—The acid is obtained by treating a neutral solution of a salt of strychnine with permanganate, added carefully in small successive quantities. The composition of the acid is represented by $C_{11}H_{11}NO_3 \cdot H_2O$. It is soluble in alcohol, but insoluble in water and ether. It dissolves readily in alkaline and acid solutions.

Bulletin de la Société Chimique de Paris.

No. 11, June 5, 1883.

Mono-nitroso-resorcine.—A. Fèvre.—The author obtains the sodium salt of this new compound by dissolving resorcine in 5 to 10 times its weight of alcohol, adding to the solution soda lye enough to form an acid sodium salt, refrigerating strongly, and stirring all the time. He then pours in gradually amyl-nitrite in the proportion of 1 mol. to 1 mol. resorcine. The acid salt of sodium monitroso-resorcine is after some time deposited as a granular brick-red precipitate.

Russian Chemical Society.—Session October 7/19, 1882.—M. Lubavine communicated the results of the analysis of the phosphorites of Ardatoff, near Nijni-Novgorod.

M. Kutcheroff has studied the action of the hydrocarbides of the acetylenic series, and in particular that of allylene upon mercuric salts. On agitating aqueous solutions of mercuric salts with allylene, there are obtained white precipitates, compact and sometimes crystalline.

M. Pavloff communicated the result of an analysis of the mineral waters of Druskeniki.

M. Moltchanowsky sent in a memoir on the preparation of azoxy-benzide by Klinger's process.

M. Samonoff contributed a paper on azoxylol.

Journal de Pharmacie et de Chimie.

Tome vii., May, 1883.

Copper and Lead in Food and in the Arts from a Hygienic Point of View.—A. Gautier.—The author shows that copper is little calculated to produce mortal results. The solubility of most of its salts, their marked colour, nauseating taste, and emetic action give at once warning. The salts of lead, on the contrary, have no pronounced taste, or are even sweetish. They are in general colourless. If introduced into the system there is no alarming effect until the nervous centres, the liver, and the blood have become interpenetrated with the poison. All foods sold in tins, especially if of a fatty nature, public water-supplies, wines, beers, effervescing drinks, the glaze of earthenware, enamels, and especially culinary utensils lined with tin, may introduce lead into the system. M. Gautier calculates that every Parisian absorbs daily $\frac{1}{2}$ m.grm. of lead salts.

Journal für Praktische Chemie.

New Series, Vol. xxvii., Parts 6 and 7.

Nitrogenous Derivatives of Meconic Acid, and their Conversion into Pyridine (Second treatise).—H. Ost.—In this extensive treatise the author describes, among the derivatives of pyrone, pyromekazonic acid, brom-pyromekazonic acid, diacetyl-pyromekazonic acid, nitro-pyromekazon, nitro pyromekazonic acid, pyromekazon-hydrate, oxy-komenaminic acid, brom-oxy-komenaminic acid, azon-carbonic acid, komenaminic acid, pyromekomenaminic acid. In his study of the derivatives of pyridine the author examines the action of phosphorus pentachloride upon komenaminic dihydro-oxypyridine-carbonic acid, hexachlor-picoline and pentachlor-picoline, monochlor- α -picoline, chloriodo-picoline, dichlorpyridine-carbonic acid, tetrahydro-monochlor-picolic acid, monochlor-picolic acid, hexahydro-picolic acid, the α - and β -oxy-picolic acids, dichlor- α -oxy-picolic acid, and monochlor- β -oxy-picolic acid. He, lastly, studies the action of phosphorus pentachloride upon komenic acid.

Amarine and Furfurine.—Dr. R. Bahrmann.—The author has examined the behaviour of amarine with acetyl chloride, benzoyl chloride, and chloro-carbonic ether. The principal results are that by the action of acid chlorides upon amarine in ethereal solution there occurs a simple addition of the reacting substances, molecular compounds

of feeble stability being formed. From an alcoholic solution of acetyl-chloride-amarine there separates out in different diacetyl-amarine. Benzoyl-chloride with amarine in alcoholic solution yields oxethyl-benzoyl-amarine. Chloro-carbonic ether with amarine in alcoholic solution, is transformed into dicarboxethyl-amarine, which, if heated with ammonia in alcoholic solution, is changed into the base dicarboxethyl-amidamarine. The author also examines the behaviour of furfurine with acetyl-chloride, benzoyl-chloride, and chloro-carbonic acid. It appears that furfurine, like amarine, forms, with acid chlorides, molecular unstable compounds, but only one atom of hydrogen can be readily substituted by acid radicles.

Antimon-trisulphide in Aqueous Solution.—In a former memoir the author has shown that like the hydrates of ferric oxide, alumina, and silica, arsen-trisulphide may occur not merely in the ordinary insoluble state, but also in a soluble form. This soluble arsen-trisulphide is readily obtained by passing hydrogen sulphide into an aqueous solution of arsenious acid free from foreign matters. The attempt to obtain in an analogous manner a colloid, soluble antimony-trisulphide was successful, but not quite satisfactory, as the solution contained only a very small quantity of the sulphide. The author refers to the fact that solutions of tartar emetic, on treatment with hydrogen sulphide, often do not form a precipitate, but merely take a deep red colour. On adding an indifferent salt, such as magnesium sulphate, the trisulphide is at once deposited in its usual state. Concentrated solutions of antimony-tersulphide are completely precipitated by hydrogen sulphide; in more dilute solutions the precipitation is less perfect and slower, and if there is only 1 part of the salt in 200 of water, there is no precipitation at all, and the liquid takes a deep red colour. No foreign matter must be present. Antimony trisulphide appears always at first as a colloidal soluble modification; its precipitation in the insoluble form is a secondary phenomenon. The author considers that it will be found practicable to obtain other inorganic bodies, known at present only in the insoluble form, in a soluble colloid condition.

Vol. xxvii., Nos. 8 and 9.

Phenyl-amido-Propionic Acid, Amido-valerianic Acid, and certain other Nitrogenous Constituents of Seedling Lupins (*Lupinus Luteus*).—E. Schulze and J. Barbieri.—The axial organs of seedling lupins two or three weeks after germination contain very much asparagin, not inconsiderable quantities of phenyl-amido-propionic acid, and amido-valerianic acid. Leucin and tyrosin are probably present, but only in very small quantities, and could not be recognised with certainty. The cotyledons contain much less asparagin than the axial organs, but this substance is still present in notable quantity after the germination has continued for two or three weeks. Amidic acids (principally leucins?) were found in the axial organs as well as in the cotyledons. Lecithin has been found in the former, and is probably not absent in the cotyledons. Peptones are found in different parts of the seedlings, but only in very small quantity.

Researches from the Chemical Laboratory of Prof. A. Saytzeff, at Kasan.—These investigations consist of a preliminary communication on the refractive power of organic compounds in solution, by J. Kanownikoff; on a by-product obtained during the preparation of allyl-dimethyl-carbinol, by W. Dief; on a hydro-carbinol obtained from ally-dimethyl-carbinol, by W. Nikolsky and Al. Saytzeff; and researches on another hydrocarbon obtained from the same source, by S. Reformatsky.

Chemico-critical Passages.—H. Kolbe.—A critique of E. Fischer's recent memoir on "Caffeine, Theobromine, Xanthine, and Guanine."

Action of Phthalic Anhydride upon the Amido-acids.—E. Drechsel.—A preliminary communication.

The author, on heating phthalic anhydride with glycoll, obtains, not uric acid, as he expected, but a new compound which he names phthalyl-glycoll, or phthaluric acid.

Brief Communications.—E. Drechsel.—These comprise a method for experimenting in sealed tubes upon the small scale. He takes a glass tube of 3 to 4 m.m. internal diameter and 1 m.m. or more thick. The tube is melted up at one end, charged, and drawn out at the other end to a long but thick sided capillary. The tube itself is from 5 to 6 c.m., and the capillary from 10 to 15 c.m. In order to apply heat the complete tube is placed in a wide and long test-tube, and is secured by means of a loosely-fitting perforated cork, so that the lower end remains at the distance of 1 to 1.5 c.m. from the bottom of the test-tube. Into the latter is then poured a liquid, selected according to the temperature to be reached, in such a quantity that the sealed tube plunges into it to half its length. Heat is then applied, regulating the flame so that the whole of the sealed tube and a part of the capillary end may be bathed in the vapour without, however, reaching the cork. —A second communication by the same author recommends the use of phosphoric instead of sulphuric acid in Pettenkofer's reaction for the biliary acids. The solid in question, e.g., a granule sodium cholalate, along with a trace of cane-sugar, is dissolved in 1 to 3 drops of a mixture of 5 vols. of commercial syrupy phosphoric acid and 1 vol. of water. The whole is heated by plunging the vessel in boiling water, when the red colouration quickly appears if a biliary acid is present.

Simple Preparation of Phenetol.—H. Kolbe.—Crude sulph-etheric acid, obtained by quickly mixing equal volumes of concentrated sulphuric acid and strong alcohol, is, when cold, diluted with water, neutralised with soda until it has an alkaline reaction, and the solution is evaporated over an open fire, until abundance of sodium sulphate has crystallised out. The warm mother-liquor is mixed with a thick solution of phenol sodium, and the whole is heated in an autoclave for some hours to the temperature of 150° under a pressure of 7 atmospheres. The solution of phenol sodium is obtained by mixing the calculated quantity of phenol and soda-lye at sp. gr. 1.33. In calculating the required quantity of phenol and sulph-etheric salt, we proceed on the assumption that half the alcohol employed is recovered as sodium sulph-etherate. On opening the autoclave the phenetol is found floating upon the semi-solid saline mixture. It is drawn off, shaken with water, and rectified. In a corresponding manner may be obtained anisol, and doubtless nitranisol and nitro-phenetol, by means of nitro-phenol sodium.

The Ptomaines: Chemical, Physiological, and Chemico-forensic Investigations.—J. Guareschi and A. Mosso.—The first portion of an extensive treatise.

Moniteur Scientifique, Quesneville.

June, 1883.

Industrial Society of Mulhouse, Chemical Section.—Session of March 21st.—M. Schatz sent in a memoir on the part played by oiling in Turkey red dyeing.

M. Poirrier, of Cholet, writes that he is the inventor of a fast grey, but he indicates neither its properties nor the method of its application.

An English memoir on improvements in bleaching wool and silk, sent in competition for the prize No. VI., was referred to M. Noelting for examination.

M. Witz read a very interesting memoir on the disorganisation of vegetable fibre by a salt of copper, which had been exposed to the sun and then to an alkaline treatment. This kind of alteration is similar to that observed by M. Jeanmaire with chromic acid.

M. Louis Durand gave an account of an American patent taken out April 27, 1881, by Armand Müller-Jacobs, of Moscow, concerning the manufacture of the sulpholeates, and consisting in the reaction of sulphuric acid upon fatty matters in general, followed by the addition of an alkali

to neutralise the product. It was remarked that the preparation and the use of this compound were described by Runge in his "Farben-chemie," published in 1834.

M. Camille Kœchlin presented specimens of a green obtained on tissues with copper phosphate. He prints the following colour:—Water, 3 litres; ammonia, 1 litre; crystalline copper acetate, 400 grms; and sodium phosphate, 800 grms. Dry, air for some hours, wash, and soap at 60°. Sodium phosphite gives a colour parallel to the phosphate; the hypo-phosphite is greener.

M. Schæffer utilises the properties of hydroxylamine for producing discharges on manganese bronzes. Its price is at present too high for practical purposes.

Discussion at the Academy of Medicine on Typhoid Fever and Microbia.—This discussion has a purely medical interest.

Conference on New Explosives.—M. Trauzl.—An account of the properties of nitroglycerin, gun-cotton, and the solution of the latter in the former, which bears the misleading names of Nobel's gelatine, explosive gelatine, or dynamite gelatine.

List of Foreign Patents.—The abridged specifications of a number of patents taken out in Germany and in England, and compiled from various journals.

Manufacture and Decoration of Porcelain.—Charles Lauth.—A paper read before the Société d'Encouragement.

Production of the Sèvres Blue on Porcelain.—C. Lauth.—Already noticed.

Utilisation of the Volatile Products of Coal.—M. Jameson.—From the *Journal of the Society of Chemical Industry*.

Carbonate of Soda as a Residue.—L. Faucheux.—The author speaks of an improvement in the alkali manufacture which he has devised. He uses as raw materials salt-cake and coal, and obtains as products caustic soda, carbonate of soda, and pure sulphur. He has no refuse to remove, and the plant of a Leblanc works will require but little alteration. He gives, however, no particulars.

The Iron and Steel Industry.—A. Jouglot.—The author speaks in general terms of the improvements of Bessemer and Siemens, and of a secret process by which 22 tons of iron can be obtained from the ore in fourteen minutes.

New Process for the Determination of Urea.—L. Hugounenq.—Already noticed.

Review of Foreign Chemical Researches.—G. de Bechi.—Extracts from the *CHEMICAL NEWS*, the *Journal of the Chemical Society*, and the *Berlin Berichte*.

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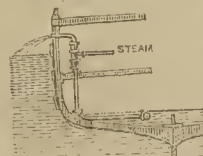
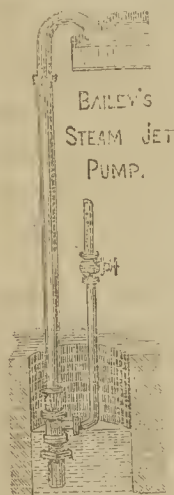
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